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MAY/JUNE 2015

SkyNews

The Canadian Magazine of Astronomy & Stargazing

THE 20th ANNIVERSARY ISSUE

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Venus and Mercury peak in altitude this spring, appearing at their best as evening 'stars.'

Jupiter ends its evening show by meeting Venus in a close conjunction in the summer twilight.

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Astro-images of astonishing quality and ethereal beauty are submitted by our readers

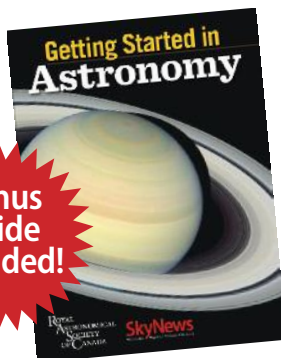
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COVER: The brilliant Pleiades star cluster, also known as M45 in the Messier catalogue, was imaged by Ron Brecher from his observatory in Guelph, Ontario, with a 10-inch f/3.6 ASA astrographic reflector. M45 is roughly 440 light-years from Earth and contains at least 1,000 stars.



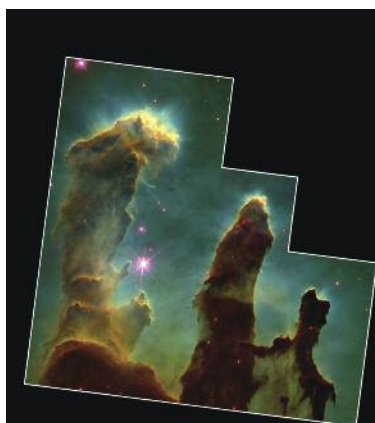
20 Years ... 120 Issues and Counting

As one of nature's greatest visual gifts, the starry night sky has never been more captivating than during the past two decades

HERE WE ARE, 20 years later. All of a sudden, it seems, *SkyNews* is a mature magazine, with readers in more than 40 countries around the world, the vast majority of which are, of course, here in Canada. Before it became the subscription/newsstand magazine with which you are familiar (the premier issue was May/June 1995), *SkyNews* was a six-page newsletter published by the National Museum of Science and Technology (now the Canada Science and Technology Museum), in Ottawa. The transition from the newsletter to a full-colour magazine came when the Museum decided the timing was right for an upgrade.

The next major evolutionary step was in 1998, when *SkyNews* became a casualty of government-wide budget tightening. To save it from early extinction, publisher Greg Keilty and I, in my role as editor, decided to take the plunge and become the owners of SkyNews Inc. As Greg explains on page 6, our loyal subscribers have made the magazine a 20-year success, and associate publisher Colleen Moloney, our subscription guru, has worked tirelessly to find new subscribers.

The soul of any magazine that measures its lifetime at more than one hundred issues is producing issue after issue that subscribers want to start reading as soon as they see it. But making it happen requires a stalwart band of reliable writers who know their subject. The two on whom I rely most are Alan Dyer and Ken Hewitt-White. Ken has been in all 120 issues and Alan for almost as many. These two outstanding creative contributors formed the core from which we grew into the robust gang of Canadian astro-talent whose names you see on the pages of each issue.



20-YEAR SEPARATION The famous Pillars of Creation image shot by the Hubble Space Telescope in 1994, above, was reprised in late 2014, right, by a new camera installed on the big orbiting telescope by space shuttle astronauts (see page 26). COURTESY NASA



Then there are the people behind the scenes who are equally creative but seldom in the spotlight. Readers often comment on the strikingly handsome design from cover to cover. I agree. Art director Janice McLean is the inspired visionary behind making *SkyNews* the best-designed astronomy magazine in the world. And production manager Susan Dickinson, with us from the outset, steers us through our production cycles while ensuring that every “i” is dotted.

HUBBLE SPACE TELESCOPE AND THE PILLARS OF CREATION

The Hubble Space Telescope was launched by the space shuttle *Discovery* in 1990. But it required some crucial early repairs, and not until 1994 did it begin to deliver jaw-dropping images of deep space, such as the portrait of M16 (above left). Because

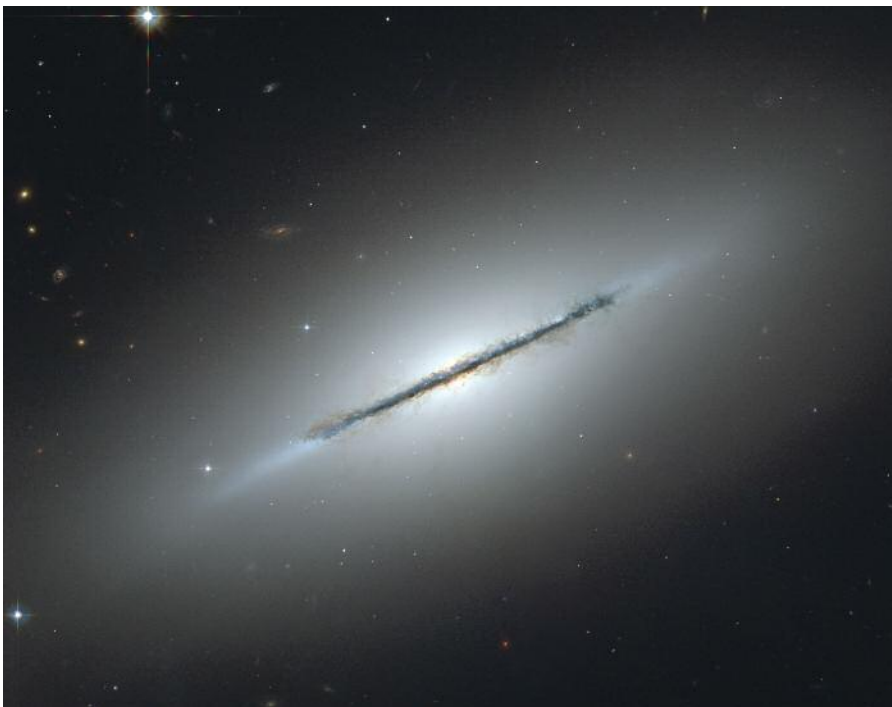
the giant columns of cosmic gas and dust are crucibles of star birth, NASA dubbed the image “Pillars of Creation.”

To mark the 20th anniversary of the Pillars of Creation image, the imaging team at the Space Telescope Science Institute, in Baltimore, Maryland, captured a new version (above right) using the third-generation camera, which was installed on the orbiting telescope by space shuttle astronauts in 2009. With twice the field of view and roughly twice the resolution, this portrait deserves prominent display (see page 26).

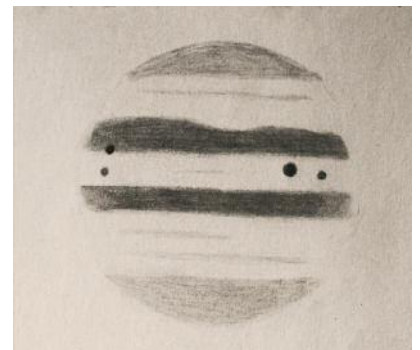
Another recent example from the Hubble Telescope’s lavish cosmic portfolio can be seen on page 10. The simultaneous passage of the shadows of three of the four large Galilean moons of Jupiter is a once-or twice-a-decade event that has never before been seen this clearly.



A FULL-BLOWN AURORA like this one, seen over Churchill, Manitoba, on February 21, was a rare sight from southern Canada over the past year. Solar activity reached the maximum of its 11-year cycle in 2014, and skywatchers were expecting better. Maybe some surprises are in store in 2015. PHOTO BY ALAN DYER

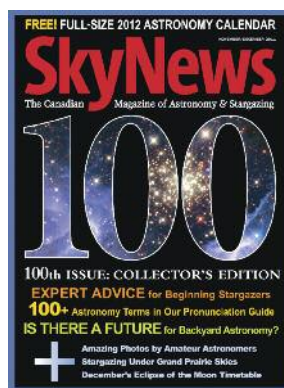
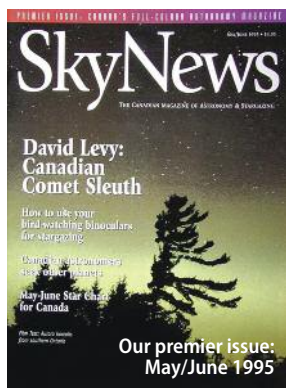


THE LENS GALAXY, NGC 5866 In this Hubble Space Telescope view, the Lens Galaxy is pancake-thin, showing dark tendrils of dust and gas that will be used as the raw material to make future generations of stars. For more information about NGC 5866 and how to observe it by telescope, see Ken Hewitt-White's column "Scoping the Sky," on page 34. COURTESY NASA/STSCI



WATCHING MOON SHADOWS

This sketch of Jupiter was made from St. John's, Newfoundland, on January 24 by Nikolay Damyanov between 3:10 a.m. and 3:15 a.m., NST, using a magnification of 150 on an 8-inch Sky-Watcher Dobsonian telescope. Seeing conditions were average, but the appearance of the big planet was extraordinary, being spotted with the shadows of three Jovian moons plus Callisto, the darkest moon, masquerading as a shadow as it transited in front of Jupiter. To sort out which is which, see page 10 (hint: the sketch was made between the times the two Hubble images were recorded).



WHAT'S OUR SECRET?

Eight out of ten magazines fail within five years of their launch. After 20 years, barely 1 in 10 is still publishing. Yet here we are, passing 20 and doing well.

by Greg Keilty, SkyNews Publisher

ANYONE STUDYING *SkyNews* would immediately point to the editor and say, "There's the secret of its success." They would be right, of course, but there's something more.

Most magazines derive the bulk of their revenue from advertising. While *SkyNews* has a smart and loyal body of advertisers, there are a limited number in Canada. Fortunately, we've been able to rely heavily on our subscribers. At times, subscribers have provided as much as 70 percent of the magazine's revenue, an unusually stable foundation—and one of the reasons for our long life.

So who are these wonderful subscribers to whom we are indebted and why have they sustained this publication for so long?

In a survey we conducted last year, 46 percent of our subscribers described themselves as beginners, 48 percent as intermediate amateur astronomers and 6 percent as experts.

When compared with the results of a reader survey conducted 12 years earlier, in 2002, our subscribers today are considerably more prosperous, travel more, spend a good deal more on astronomy equipment and do more observing.

Our subscribers identified the five things they like best about *SkyNews*: the quality of the photography and printing; the Canadian content; the seasonal star charts; the news about special astronomical events; and the reviews of astronomy products and services. We couldn't help smiling when more than three-quarters of the survey respondents reported that *SkyNews* is their first choice for information about amateur astronomy.

More than one-third of our subscribers regularly photograph the night sky. Surprisingly, only one-fifth feel that their observing site is severely light-polluted.

While 77 percent said they prefer to read *SkyNews* in print, 21 percent would like to have both print and digital editions. Just 2 percent prefer a digital magazine only.

And here's something to ponder: 66 percent reported that they have been interested in amateur astronomy since the Moon landings in the 1960s and 1970s.

On behalf of all of us at *SkyNews*, I would like to extend a sincere thank-you to our subscribers for their unwavering support over these 20 years and for their enthusiasm for reading about and observing the wonders of the universe.



One more Hubble example is the Lens Galaxy on the previous page. Here, we see what is probably a spiral galaxy viewed exactly edge-on. Once again, more detail is visible in this image than has been revealed by any other telescope. This is especially true when compared with the visual appearance in a telescope. Recalling my last peek at NGC5866 in my 10-inch reflector a couple of years ago, I saw a haze with a small, darkish dash at its middle indicating the dust lane. I was happy just to be able to detect that across the 50-million-light-year gulf between Earth and this galaxy. And that's the lure of recreational astronomy—actually seeing the universe for real.

The Hubble Space Telescope's high-powered eye on the universe and its accompanying discoveries have, fortuitously, almost exactly paralleled the two-decade span of *SkyNews*. I believe that Hubble has, more than anything else, bolstered interest in astronomy in the 21st century.

GETTING STARTED IN ASTRONOMY

When pursuing any hobby or avocation, getting started can often be the most difficult part. The concise eight-page guide that accompanies this anniversary issue is a joint project between *SkyNews* and The Royal Astronomical Society of Canada and is intended as an aid to the beginner. That person may be you or someone you know.

Getting Started in Astronomy is written by Gary Seronik, an experienced amateur astronomer and lunar observer, an astronomy writer and one of our regular columnists, a telescope expert and the editor of the *SkyNews* website (skynews.ca). Gary is the ideal guide to the night sky. He introduces a variety of celestial phenomena revealed by the unaided eye and in binoculars, such as another galaxy of stars similar to our home galaxy, the Milky Way, two million light-years distant. Exploring the night sky is, in many ways, like a sightseeing tour of exotic foreign lands.

As with any journey, the appreciation of the tour can be greatly enhanced when you prepare for the venture. Reading *Getting Started in Astronomy* is a good step in that direction, while perusing every issue of *SkyNews* and regularly scanning skynews.ca will keep you current. ♦

Editor Terence Dickinson invites you to send your comments, astronomy observations and photos to dickinsonSkyNews@gmail.com.

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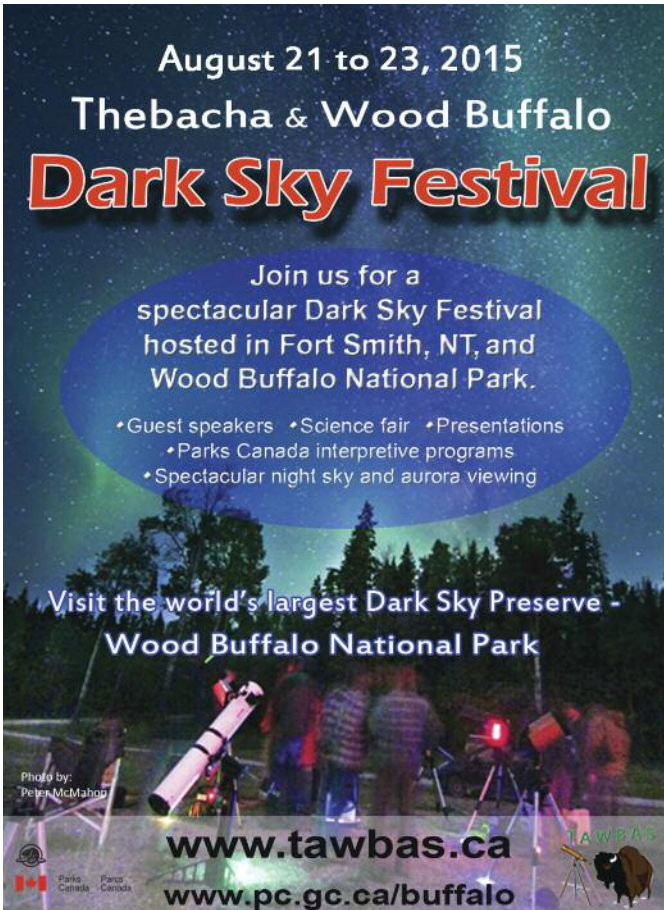
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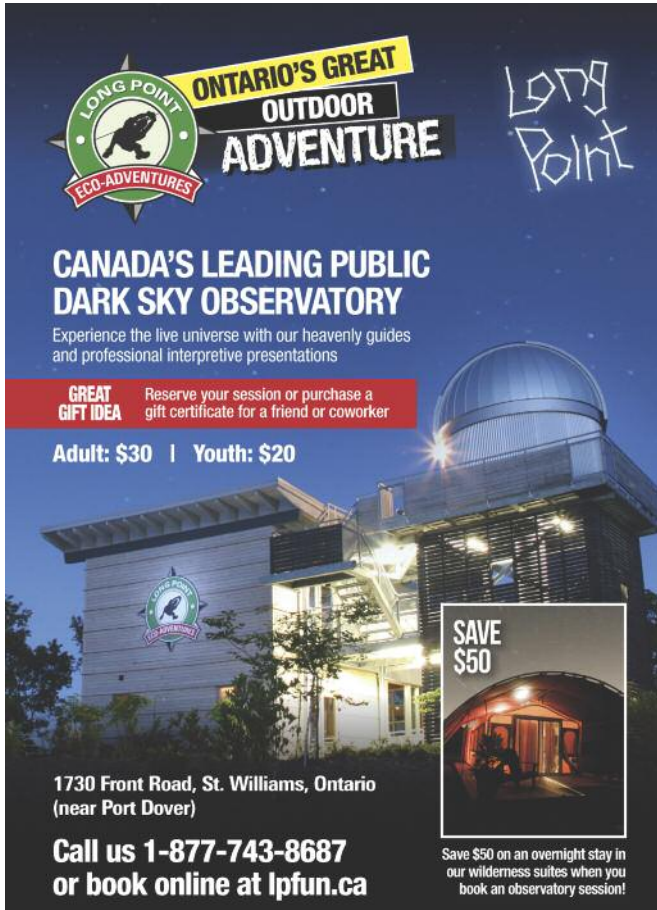
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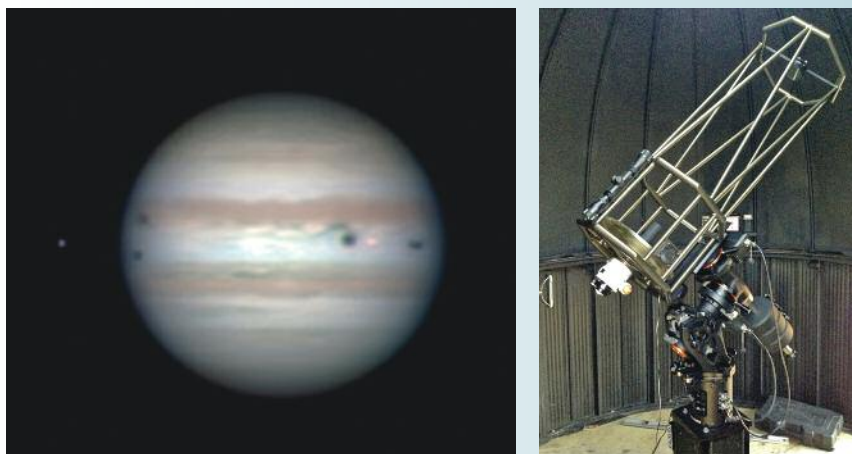
SHADOW PLAY

Here is my crack at the triple-shadow transit on Jupiter on January 24. This image was taken between the clouds, while I was sitting in my observatory freezing and hoping that something good would come out of my efforts. I'm quite happy with the results I achieved under extreme conditions that night. I'm an amateur telescope maker, and I built my steel-truss telescope, pier and domed observatory with motorized shutters. The 12.5-inch Dall-Kirkham telescope optics are by R. F. Royce. The scope sits on a Celestron CGE Pro mount and is fitted with a Flea3 CCD camera.

Mike Pataky

South Woodlee, Ontario

Editor's Note From left to right in Jupiter image: Europa, Europa's shadow (lower), Callisto (upper), Callisto's shadow, Io (pinkish), Io's shadow. See page 10 for Hubble pictures of the event with the moons identified.



KUDOS ON 20 YEARS

On behalf of The Royal Astronomical Society of Canada, I offer our sincerest congratulations on achieving a 20-year milestone of publishing a great Canadian astronomy magazine. *SkyNews* continues to offer readers timely topics and amateur insights for both current and upcoming daily events. You and your staff of writers, photographers and graphic artists support outreach efforts, educate and inform and help hone amateur astronomy skills. We in the Society cherish the 18-year partnership we have enjoyed, and we look forward to many more to come.

From a personal perspective, I was a charter subscriber way back when *SkyNews* was a newsletter from the Canada Science and Technology Museum, long before I joined the RASC, and I've seen the magazine grow from that early slender volume to the classy 50 pages or more of today, chock full of good advice for amateurs and professionals alike. Good on you!

James Edgar, President

The Royal Astronomical Society of Canada

LIGHT-POLLUTION-ABATEMENT ADVOCACY

Most amateur astronomers recognize light waste and pollution as the major problem in observing. But the situation is far more serious and insidious than many realize. It wastes electrical and financial resources and increases taxes and greenhouse gases.

It affects not only the community but also areas far beyond its borders. It creates grave health issues, including breast and prostate cancers. It promotes sleep deprivation accompanied by psychological, sociological and physical problems. Loss of the dark sky at night diminishes our cultural heritage and denies those who appreciate a starry-night environment. Research indicates that these negative effects are serious, numerous and very real.

A website (www.albertadarksky.ca) has been set up to help establish light-efficient communities anywhere in Canada. The website contains a quick course on light waste/pollution, its sources and its negative effects. A wealth of other vital resources was created and collected for the advocate and

for educational programs, which are key to success. Educational handouts, policies, posters, reports and guides are free and in the public domain. They are easily downloaded, used, copied and distributed. This website exists to help you organize and utilize an advocate group. The group can then offer advice to city councillors and administrators, the people who make the decisions on lighting in your community.

Rod E. McConnell, M.Ed.

President, Alberta Dark Sky Association

e-mail: rodemcc@shaw.ca

JUPITER IN SUPERB SEEING

While on vacation in Costa Rica in February of this year, I travelled with a Celestron NexStar 6SE Schmidt-Cassegrain telescope. I used the scope with a MallinCam SSIC and a 2-inch Barlow in altazimuth mode to photograph the planet Jupiter, capturing 1,000 frames, 800 of which were processed in RegiStax and finished off with the free software program PhotoPad.

The resulting image, below, shows considerable detail, including the black shadow of the Jovian moon Io. The moon itself is barely visible as a buff-coloured spot to the right of the shadow, largely concealed because of its similar hue to the Jovian equatorial zone [see page 10 for a high-resolution Hubble reference].

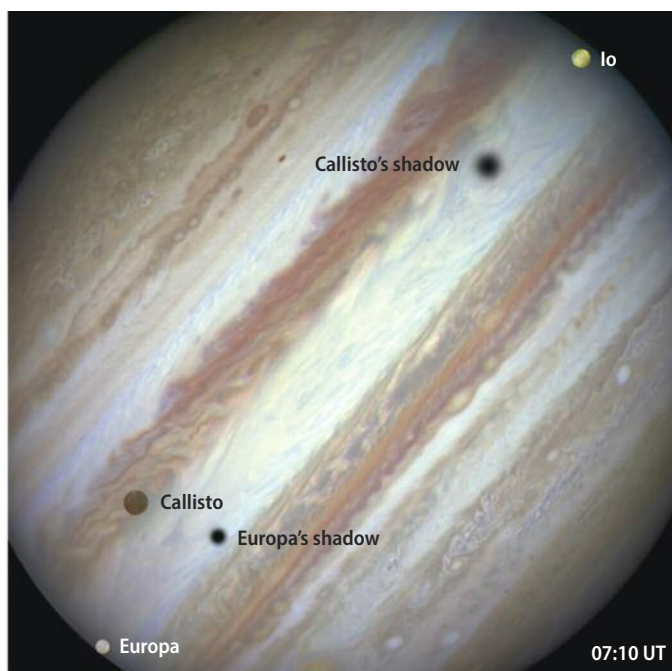
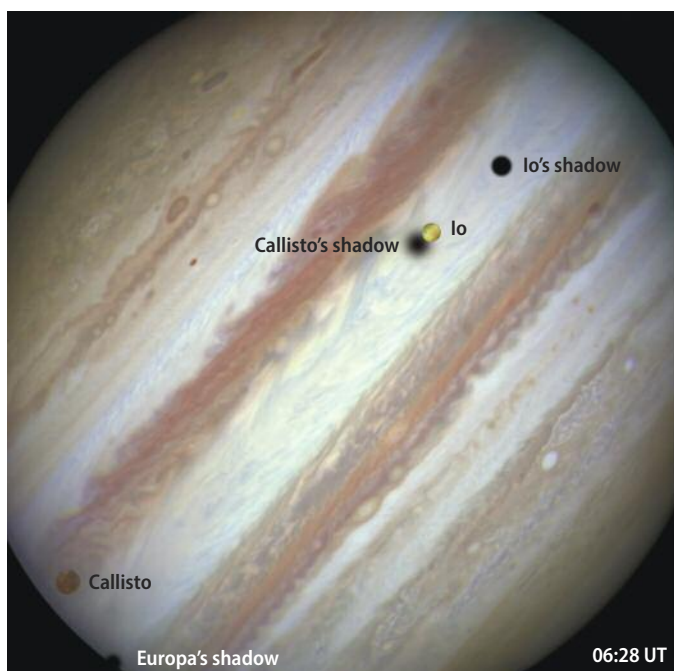
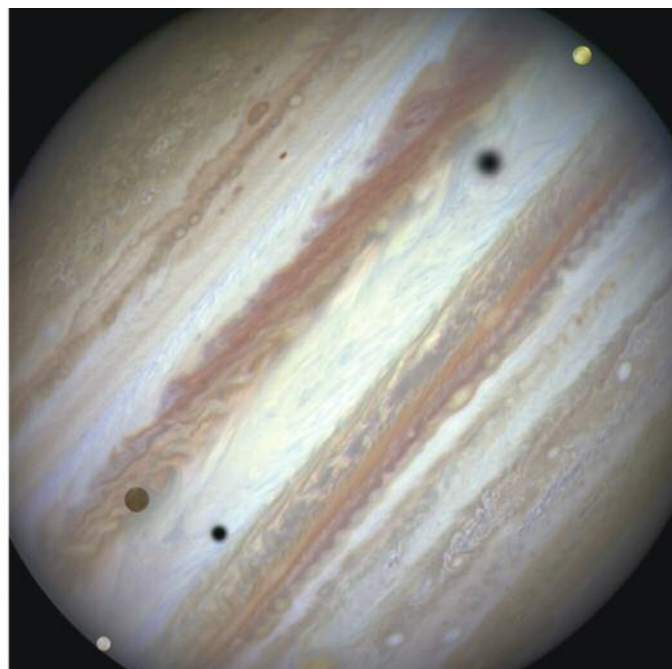
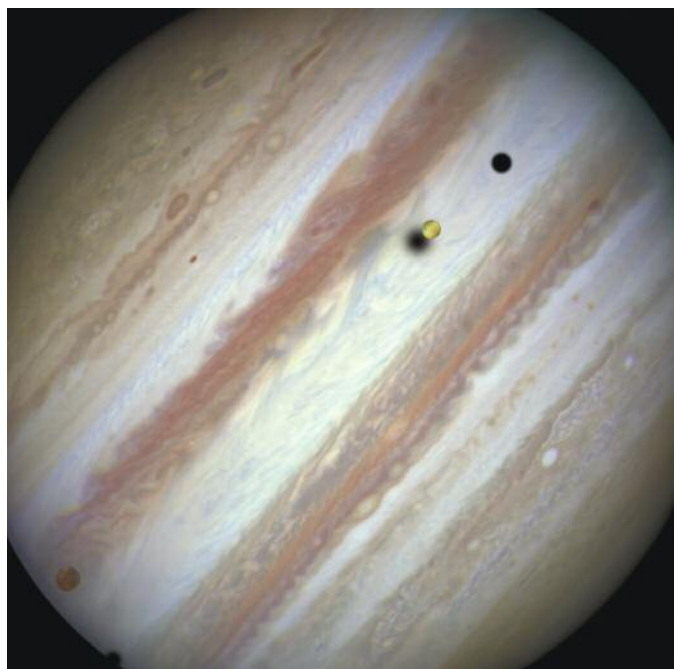
Tom Owen

Edmonton, Alberta



SUBMITTING LETTERS AND PHOTOS

SkyNews editor Terence Dickinson welcomes notes on your astronomical observing activities as well as comments about anything you read in the magazine. Submit photos in jpeg format to: dickinsonSkyNews@gmail.com.



JOVIAN MOONS DANCE IN FRONT OF JUPITER

Hubble Space Telescope captures a rare show on January 24 as three moons and their shadows perform

FIRING OFF A STRING OF SNAPSHOTS like a fashion photographer, NASA's Hubble Space Telescope records three of Jupiter's big moons—Europa, Callisto and Io—zipping across the banded face of the gas giant. While Jupiter's four largest moons are commonly seen transiting the face of the giant planet and casting their shadows onto its cloudtops, seeing three moons in transit at

the same time is uncommon, occurring only once or twice a decade. Missing from the sequence is the moon Ganymede, which, at the time this image was taken, was too far from Jupiter in angular separation to be part of the conjunction. (Orbital mechanics dictate that all four large moons can never be in front of the big planet together.) The two lower images, with labels, are duplicates of the images at top.



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COMET LOVEJOY CRUISES THROUGH THE WINTER CONSTELLATIONS

COMETS are the stand-up comics of astronomy. We never know whether they will light up the celestial stage or fall flat—or lie somewhere in between. Some, like the much-ballyhooed Comet ISON of 2013, simply disappear when the curtain opens. Others quietly emerge from nowhere to thunderous applause and instant fame.

In the pantheon of comets, the recent Comet Lovejoy greatly exceeded astrophotographers' expectations and provided an interesting show for binocular observers in January and February as it cruised high in the winter sky during convenient evening hours. And, as an added bonus, the comet surpassed brightness predictions by more than a magnitude.

On dark moonless nights when the comet was at its best, astrophotographers gathered some impressive comet portraits, such as the images we present in this gallery. Astrophotography is the most popular hobby within astronomy—and for good reason. On the walls of my observatory, I proudly display framed pictures of planet conjunctions, nebulae, galaxies and, of course, comets that I have taken over the years, some dating back to the 1970s. Using today's more capable digital cameras and equipment, astrophotography is more rewarding than ever.

—Terence Dickinson

IN TIMES LONG PAST, COMETS WERE 'HAIRY STARS'

Canadian astro-imager Jack Newton took this remarkably detailed portrait of the diaphanous gas tail on Comet Lovejoy on January 16 from his winter observatory in Arizona Sky Village, near Portal, in southeastern Arizona. Using a Meade 14-inch Schmidt-Cassegrain telescope fitted with a HyperStar f/2 astrographic imaging system, Newton took two exposures, then digitally stitched the two together in Photoshop. The gaseous filaments so clearly evident here are being "blown" by the solar wind—a stream of charged particles released by the Sun. The name "comet" derives from the ancient Greek word for "hair"; hence comets were called hairy stars.



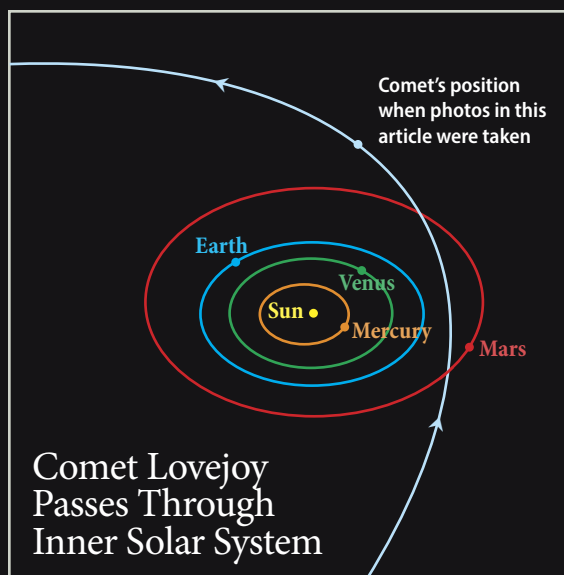


COMET GLIDES PAST THE PLEIADES, JANUARY 17

The delicate tail of Comet Lovejoy spans 15 degrees in this photo by Steve Altstadt, who used a Canon 5D Mark III DSLR camera to take multiple 2.5-minute exposures at ISO 1600 with a 135mm f/2 lens at f/2.8 on an AstroTrac system. It was shot from a snow fort(!) near Morden, Manitoba.



COMET GALLERY



VISUAL APPEARANCE

This image of Comet Lovejoy, taken by Gord Rife on January 12 from Schomberg, Ontario, is pretty close to how the comet looked in binoculars or a backyard telescope on moonless nights in January and February. Even modest optical aid revealed the comet's faint tail and the obvious fifth-magnitude fuzzball of the coma. The photo consists of 39 frames (117 minutes combined imaging): 19 images at 180 seconds at ISO 400 with a Canon 60Da and a William Optics 66mm refractor with 0.8x flattener for f/4.8; and 20 frames at 180 seconds with a Stellarvue 80mm refractor and 0.8x flattener for f/4.8.



EXTREME WIDE ANGLE

Stationing himself at City of Rocks State Park, in southwestern New Mexico, Alan Dyer took this ultra-wide-angle view of Comet Lovejoy with the winter Milky Way arching from Orion, on the left, to Perseus, at upper right, on the same night he captured the photo on the facing page. Zodiacal light—sunlight illuminating fine dust in the plane of the ecliptic—is particularly bright in the clear desert air.



20 DEGREES OF COMET TAIL

SkyNews associate editor Alan Dyer took this image from southwestern New Mexico on January 16 under perfect conditions. He caught Comet Lovejoy crossing the ecliptic as it travelled through Taurus. The long exposure shows the comet amid the star clusters, nebulae and dark clouds of Taurus and Perseus. The Pleiades star cluster is above the comet; the red at upper right is the California Nebula.

COMET GALLERY

ROCKET TO A SMALL COMET

Comet Lovejoy rides high over NASA's Kennedy Space Center during the launch of an Atlas V rocket on January 20. *SkyNews* contributing astrophotographer Lynn Hilborn took this image from Florida's Apollo Beach, at Canaveral National Seashore, using a filter-modified Canon 6D camera and a Samyang 14mm f/2.8 lens at f/4 guided by a Vixen Polaris tracker. For the comet and the starry backdrop, Hilborn took eight consecutive 3-minute exposures at ISO 1600. The initial launch sequence was a 3-minute shot at f/8 and ISO 100.



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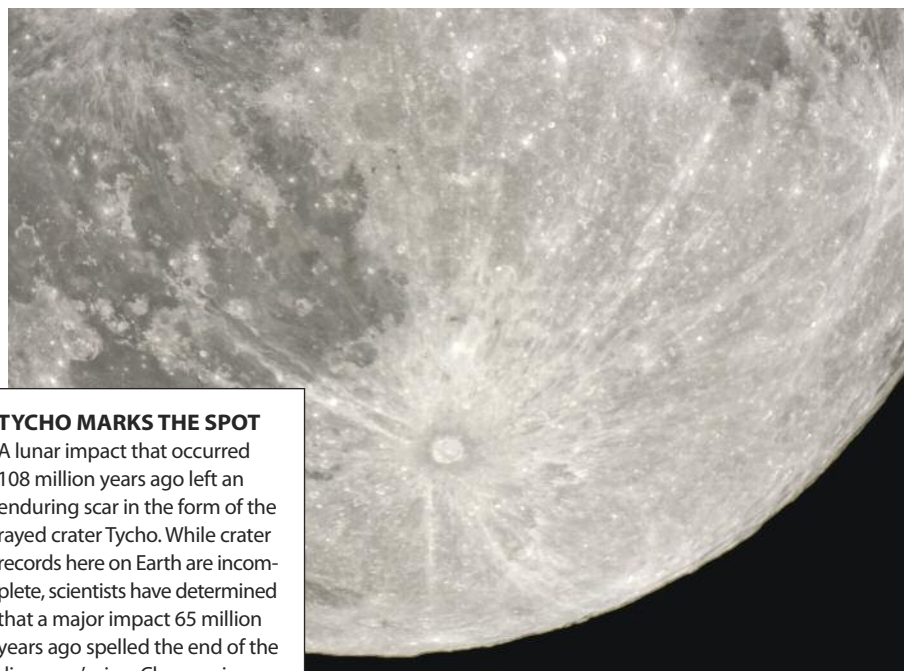
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on its 20th anniversary.



Waiting for the Big One

Both Earth and the Moon bear the scars of cosmic collisions—some catastrophic, some minor. Are we long overdue for a life-changing impact from an asteroid or a comet?

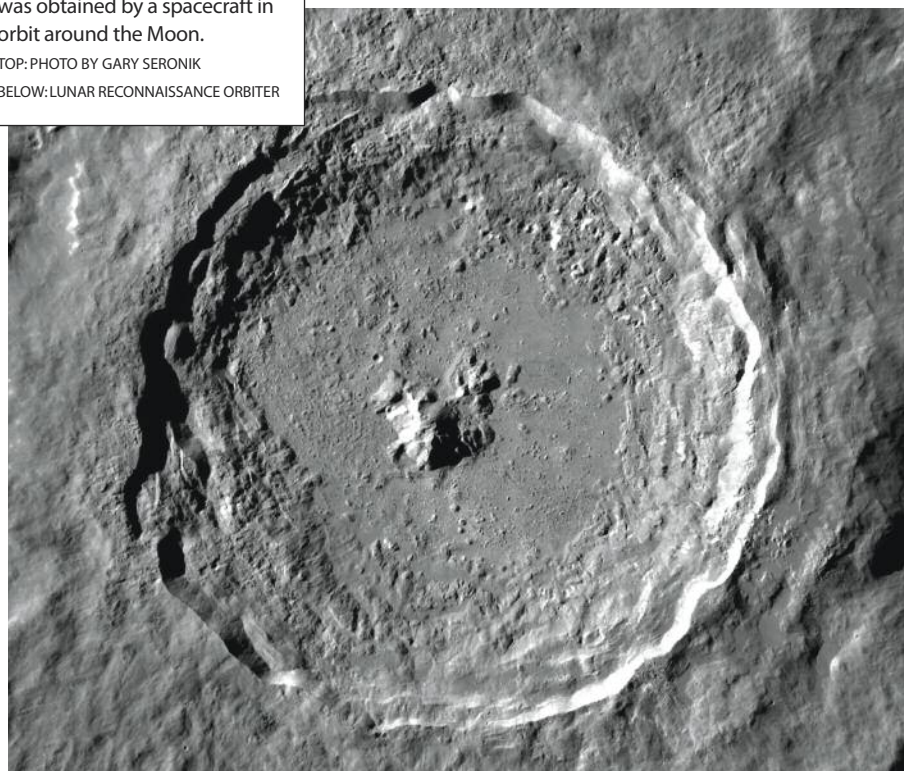


TYCHO MARKS THE SPOT

A lunar impact that occurred 108 million years ago left an enduring scar in the form of the rayed crater Tycho. While crater records here on Earth are incomplete, scientists have determined that a major impact 65 million years ago spelled the end of the dinosaurs' reign. Close-up image was obtained by a spacecraft in orbit around the Moon.

TOP: PHOTO BY GARY SERONIK

BELOW: LUNAR RECONNAISSANCE ORBITER



ON THE WEST COAST, we live with the dread certainty that the “big one” is coming. It’s not a matter of *if*, but a question of *when*. The big one I’m referring to is a major earthquake. Recently, a new report came out stating that there’s a one in ten chance of a megathrust earthquake occurring here within the next 50 years. Yikes! I prefer to think that there’s a nine in ten chance that it won’t happen. Makes it easier to sleep at night. But if such a seismic cataclysm were to happen, as bad as it would be for those of us in the immediate vicinity, it’s unlikely that the event would threaten civilization as a whole. The real big one is going to come from space—an asteroid with our name on it.

What are the odds of catastrophic impact? Not zero. Beyond that, it’s hard to estimate. When the subject is discussed in scientific circles, “negligible” is the term that is regularly tossed around. So why worry? Because in the world of risk assessment, there are two factors to consider: *probability* and *consequence*. Slipping in the bathtub is a high-probability/low-consequence (except to the person who does the slipping) risk. A civilization-ending asteroid impact falls at the low-probability/high-consequence end of the scale. It’s unlikely to happen, but if it does, it’s *really* bad news.

Much of what we know about cosmic collisions comes from examining the Moon. Preserved on its dusty surface for all to see is a detailed record of impacts stretching back billions of years. And as the idiom has it, what’s sauce for the goose is sauce for the gander. As frequently battered as the Moon has been, Earth, being a much bigger target, has endured even more. But the cratering record on our planet is patchy at best, thanks mainly to the effects of erosion, which has, to a large extent, wiped the slate clean. Plus our dense atmosphere protects us from the small stuff. Even so, we know of 188 impact structures on our planet,

31 of which are found in Canada alone.

By carefully examining the lunar surface, we have learned two important facts about the cratering history of the inner solar system. First, the largest craters tend to be the oldest, which tells us that the biggest impacters—the ones we need to worry most about—are far less numerous now than they were when the solar system was young. Second, there are far fewer big craters than little ones.

You can verify this yourself with your telescope. Select any heavily cratered part of the lunar surface, and count the number of big, medium and small craters in a confined area. Since big craters = big impacters, we can take comfort down here on Earth in knowing that historically, catastrophic impacts are the rarest of all. Indeed, the most recent extinction-level impact on our planet was the one that ended the reign of the dinosaurs 66 million years ago.

But what about the Moon? Small impacts occur regularly, but since the invention of the telescope more than 400 years ago, no new crater large enough to be seen from Earth has been found on the lunar surface. The most recent really big crater is Tycho. Measuring 85 kilometres across and featuring ejecta rays that span more than half the lunar globe, Tycho likely formed 108 million years ago, when an asteroid fragment several kilometres wide slammed into the Moon. That's very recent by lunar standards. Most craters of Tycho's size are much, much older.

Take a moment to inspect Tycho and its ray system with your telescope, and you'll appreciate the incredible energies unleashed by that awesome impact. Some of the ejecta from Tycho's formation would probably have rained down on Earth, creating an impressive meteor shower. Of course, 108 million years ago, no humans were around to see it. But perhaps a few bright meteors caught the attention of some especially alert dinosaurs. Those creatures could not have imagined that their very existence would eventually be doomed by another "big one" from space. ♦

Gary Seronik is the editor of this magazine's website, SkyNews.ca.

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Photo of the Week

The Pleiades by Mike Bonin
[Read more >](#)



Enjoy Comet Lovejoy

A recently discovered comet is making its way across the winter sky. [Read more >](#)



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Open Cluster M52 by Art Cole
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Gibbous Moon by Ron Brecher
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Editor's Report: Readers Capture Eclipses

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The MallinCam UNIVERSE

represents years of design and research in a colour CCD camera that is capable of live constant refresh with a maximum download of one second per frame. The new Constant Refresh System (CRS) is a first in a CCD camera, in which the CRS software downloads a live image for full-frame review on your computer monitor. The camera acts as a video system, displaying a non-stop new image at every exposure.

The MallinCam UNIVERSE is 100% USB 2.0 controlled, and the image is also transferred through USB. A deep-cooling system with a sealed sensor chamber allows cooling to reach -45°C to ensure the lowest noise and dark current where, in most cases, a dark frame is not generally required. **A first in the industry.** Taking publication-quality images is now possible and easier than ever with this new system. A constant live image is displayed for those who wish to use the camera as a live observing system. With its super-large sensor, its total optical diagonal size of 28.4mm across and its large pixel size of 7.8×7.8 microns, the camera excels in delivering live colour images. The CCD sensor has a total of 6.31 mega-pixels. The sensor's horizontal size is 25.10mm, and its vertical size is 17.64mm. The active pixels (6.11 mp) deliver a total size of 3032×2016 . The New MallinCam UNIVERSE can also be switched from colour mode to black and white with a click of the mouse.

Live processing is done on the fly using features such as full histogram adjustment, full gamma range, full contrast range and auto white balance or manual RGB colour balance.

The unique "Hyper Circuit" found on all other MallinCam systems has been incorporated into this new design, allowing the MallinCam UNIVERSE to deliver a total variable gain of $26.06 + \text{db}$, a dynamic range of 80 db and a signal-to-noise ratio of 60 db.

The MallinCam UNIVERSE comes complete with a 5-metre USB cable; a 2" threaded adapter; a 1.25" converter, allowing the use of an optional 1.25" eyepiece adapter; 110 volts AC to 12 volts DC power supply; driver; and software CD-ROM.

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The MallinCam Jr PRO

MallinCam announces the return of the original MallinCam PRO – now with additional features. This new camera is called the MallinCam Jr PRO.

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The Jr PRO can be purchased with either the standard 1/2-inch-size Sony ceramic CCD sensor (Cer-Dip) or the optional EXview HAD sensor for an additional \$100.00. Either type of CCD sensor is available in colour or B&W.

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- 32-Bit DSP Micro Processor.
- Now includes RS 485 ready rear socket camera control.
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- WDR: Combines two fields (high shutter speed exposures taken in bright light and low shutter speed exposures) into

one composite image to help see the dark and bright parts of an image. This feature can extend shutter speeds above 17 seconds without saturation. A unique MallinCam system.

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NEW! The MallinCam XTERMINATOR

The MallinCam Xterminator is the finest, most advanced video CCD camera ever created for astronomical work by anyone. It has a new 14-bit DSP processor, dual preamps and dual bias algorithm, allowing continuous automatic adjustment of the CCD sensor regardless of the exposure. It also has the latest ICX828 EXview HAD II CCD ceramic sensor (CirDIP), available in Class 1 astronomical grade and Class 0 grade as an option. The new A/D converter to DSP has been reconfigured to deliver the cleanest image ever seen in a live video CCD camera, even with short exposure times.

Features:

- Sealed CCD chamber with 1/4" optical multi-coated glass.
- High-grade argon-gas-filled sensor chamber.
- New ICX828 EXview HAD II series ceramic (Cer DIP) sensor.
- Large 1/2" Micro Lens Technology CCD sensor.
- Anti-dew coatings on the CCD sensor and internal optical window (a MallinCam exclusive).
- New Holtek dual preamps configuration for greater gain (a MallinCam exclusive).
- New 14-bit DSP.
- New A/D converter configuration at the DSP (a MallinCam exclusive).

- Correlated double sampling (a MallinCam exclusive).
 - Good suppression of CCD output low-frequency noise is achieved through the use of S/H-type correlated double sampling.
 - A high S/N ratio is achieved through the use of an AGC-type dual amplifier, and high sensitivity is provided by a wide cover range (a MallinCam exclusive).
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DON'T LEAVE HOME WITHOUT IT



Here's how you can ensure a successful stargazing trip when you venture beyond the backyard *by Gary Seronik*

remember to bring everything you need most of the time, but eventually, you'll scan your list and spot something you've forgotten. That's when you'll be glad you took the time to make a checklist.

OBSERVING AWAY FROM HOME

It's a sad truth of modern life that most of us must leave our backyards behind to escape the pall of urban light pollution and enjoy dark skies. Certainly, packing up the car for a night of stargazing has become a familiar routine for many observers. Just remember: It's one thing to forget a favourite eyepiece if you only have to walk from your backyard into your house, but it's quite another when you're a one- or two-hour drive from home.

For trips to a local observing site, I like to keep things simple by leaving a few items, such as a folding chair and a TV table, in the car more or less permanently. I keep other equipment in a carry bag that's always ready to go. When I've finished loading the car, I quickly run down my checklist to make sure I haven't forgotten something important. It's a simple final step that has saved me more than once.

In addition to regular trips to nearby observing sites, I also venture farther afield to attend a few star parties each year. These outings usually mean a stay of several days at sites that are often away from easy access to power and supplies. I keep a second, longer checklist for such occasions. The additions are mainly consumables, such as battery power for the scope's drive and cooling fans, and a few extra pieces of equipment that I don't normally use on a one-night outing.

If you enjoy taking pictures of the night sky, your equipment checklist will, of necessity, be considerably longer. Not only do you need to pack all your regular gear, but you must bring your photographic accessories as well: a spare camera battery, cords and cables, guiding equipment, a computer, and so on. Frankly, I have no idea how anyone can attempt astrophotography away from home without a detailed inventory.

To ensure that your list has all the essentials, do a dry run in

TRUE STORY. When I lived in Vancouver, members of the local centre of The Royal Astronomical Society of Canada did most of their observing from a municipal park about an hour's drive away. I could count on seeing many of the same friendly faces there on virtually every clear, moonless weekend. On a particularly fine night, one of our group's regulars unpacked his portable Dobsonian only to discover that he'd neglected to bring the four bolts that join the scope's upper tube section to the mirror box. A moment of forgetfulness rendered his telescope useless for the night. I'm certain most readers have similar stories to tell.

Even a routine night under the stars can involve a fair amount of gear. Each item is a link in a long and surprisingly fragile chain. If one link fails, the result can be a fruitless night. On another outing at the same observing site, the battery in my red flashlight died, and for want of a \$2 battery, the night was nearly lost. I couldn't read my star charts, make observing notes or change eyepieces without fumbling around. To top it all off, while disassembling my telescope at the end of the session, I dropped an important screw. Only through blind luck was I able to find it. And that was when I finally resolved to compile an inventory of everything I need for a night with my scope.

A checklist serves as a kind of insurance policy. You'll probably

the backyard one afternoon. Set up all your gear as you would for a night under the stars, then compile your list, piece by piece, as you take each item back into the house. This definitely requires some effort, but for most, it's a one-time-only exercise.

BEYOND THE ESSENTIALS

A dry run will populate your checklist with pretty much everything you normally use, but here are a few items from my own inventory that you may want to add to yours:

BATTERIES. If any piece of gear uses a battery, pack a spare battery for it. And don't forget those little coin-sized batteries that power red-dot finders and camera accessories. They last so long, it's easy to forget about them—until they die.

LENS CLEANING KIT. I always pack a Ziploc bag containing a few cleaning essentials, such as a photographic blower brush, a dozen Q-tips, a small plastic bottle of lens cleaning fluid and some lotion-free tissues. Eyepieces and filters, in particular, seem to attract a lot of dirt and fingerprints in the field.

WHITE-LIGHT FLASHLIGHT. Use this only for emergencies or when you're getting ready to go home. It's never a bad idea to do a quick sweep of your observing site to make sure you've packed up everything you brought. I know someone who drove off in the dark having left several eyepieces on the bumper of his car! Suffice it to say, the results weren't pretty.

A TOQUE. No matter what the season, the night can become uncomfortably chilly. A toque, or woollen hat, takes up very little space yet makes a big difference when the need arises.

SNACKS. I always keep a few granola bars in the car. A quick pick-

me-up when your energy is flagging can help extend your observing session. After all, if you've driven an hour to get to your site, it would be a shame to go home earlier than necessary.

ASTRO TOOL KIT. It's always a good idea to pack a set of hex wrenches, a screwdriver, a roll of electrical tape and a cheap digital voltmeter. Field repairs are never fun, but a quick fix is better than a long drive home after a disappointing night under the stars.

DIGITAL VOICE RECORDER. An observation unrecorded is an observation not made. I used to jot down my field notes with a pencil and paper, but I find it is much easier to dictate them using a voice recorder or a smartphone, since it requires only one hand and no light. When I get home, I transcribe my observations into my log.

INSECT REPELLENT. No explanation needed—this is Canada!

Finally, it's important to keep in mind that experience is the best teacher. Whenever I find myself saying, "It sure would have been nice if I'd brought along..." I add another item to my checklist. In time, your inventory will grow to be so complete that you will rarely have such a moment. The easiest way to manage your observing checklist is to enter it on your computer so that it can be readily updated and modified. Print out a copy, and keep it near your telescope as a reminder. You'll be glad you did. ♦

An award-winning author, Gary Seronik regularly observes far from home, in such diverse locations as Iceland and Costa Rica. He is editor of this magazine's website, SkyNews.ca.





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Antarctic Cosmology

A stratospheric balloon experiment successfully probes the early universe

HIGH IN THE STRATOSPHERE, a strange device dangles from a helium-filled balloon. Below lies a frozen wasteland; above, the darkness of space. At 36 kilometres altitude, the sky is no longer blue. Suddenly, a radio signal from a distant control centre triggers a mechanism that cuts the balloon loose. The three-tonne device plummets toward Earth.

Two weeks later, the device is lying on a vast ice sheet. It is half buried in drifting snow and still attached to the parachute it rode down to the ground.

Boots crunch, figures approach. A British team has located the device. They clamber onto its crumpled frame and carefully remove a set of drives carrying a precious cache of data. These are taken to a remote base in Antarctica, then flown to Punta Arenas, near

the southern tip of Chile. There, the drives are handed off to another team, this time Canadian and American, who spirit them back to North America.

It reads like the opening to a spy novel, but it's the real-life account of how cosmologists working with the SPIDER project recently recovered what could turn out to be some of the most important observations ever made of the early universe.

"There's no bigger thrill," says William Jones about the experiment's 17-day balloon ride, nearly a decade in the making. A physicist at Princeton University, Jones is one of several team members now wading through the roughly 1.3 terabytes of data that were gathered while SPIDER was aloft.

SPIDER is a flying detector built to scan the cosmic microwave background (CMB), a relic signal coming from every direction in the sky that originated only 380,000 years after the Big Bang. Back then, all of space was aglow with energized particles, like a uniformly brilliant fog. But there were subtle differences in the fog—varia-

tions in particle density that were generated long before, when the universe was a fraction of a second old and space was thought to be rippling with waves of gravitational energy.

SPIDER was designed to sift out those variations, which should appear as a telltale pattern

that is visible only by looking at the CMB through the microwave equivalent of polarized sunglasses.

It's exactly the pattern that researchers conducting another experiment, BICEP2, thought they had seen last year. Their announcement caused a sensation because it seemed to offer evidence in favour of cosmic inflation, the dominant theoretical model that describes how the universe



COLD CALL A team from the British Antarctic Survey examines SPIDER, a balloon-borne detector that touched down in a remote part of Antarctica on January 17, before retrieving hard drives carrying measurements of the cosmic microwave background—to the delight of the SPIDER mission team, based in the United States and Canada.



began. But the find was a false alarm. Last January—just before SPIDER's data were recovered—a careful comparison of the BICEP2 and European Space Agency's Planck mission datasets showed that the crucial patterns seen by BICEP2 were generated by dust in the Milky Way, not by primordial gravitational waves.

That means the hunt for gravitational waves from the early universe is still wide open, and SPIDER could be in the lead. The experiment was partly built in Canada by team members at the University of Toronto and the University of British Columbia, and its dramatic first flight looks to have been an unqualified success. The only wrinkle in the mission was the unexpectedly elaborate effort required to retrieve SPIDER's data.

SPIDER was launched on January 1, 2015, at the McMurdo Station in Antarctica after many delays due to poor weather. As with previous balloon experiments, it was meant to drift westward on the prevailing winds,

tracing a big counterclockwise circle around the South Pole. However, the winds were slower than average this past season, so when SPIDER finally ran out of the cryogen needed to cool its detectors, it had completed only half of its circumpolar flight.

"That gave us all the observing time we could have hoped for," says Jamil Shariff, a University of Toronto doctoral student who was part of the SPIDER flight team. Normally, the team would simply have waited for the winds to carry SPIDER back to McMurdo, but the winds were also blowing slightly northward, putting the detector on a spiralling path out to sea. To avoid that, the flight was terminated while SPIDER was still over land, some 2,400 kilometres away from McMurdo, on the other side of the continent.

Staff at the British Antarctic Survey saved the day. Flying out of a deep field station known as Sky Blu, which is only 470 kilometres from the location where SPIDER touched down, they were able

to find the detector and retrieve the data. Until a larger recovery operation can be mounted, the rest of SPIDER will remain where it lies.

Recovering the device is crucial because SPIDER's journey is only half completed. In order to better distinguish galactic dust emission from the elusive traces of gravitational waves, SPIDER is meant to fly twice and provide two sets of observations at two separate microwave frequencies.

The second flight is at least a year and a half away. If that flight goes as well as the first, SPIDER's definitive verdict on the origin of the universe will be available by 2018, says Barth Netterfield, a professor and researcher in observational cosmology at the University of Toronto.

Meanwhile, thanks to some timely international teamwork, a doorway to the Big Bang stands half open. ♦

Ivan Semeniuk is a science reporter for The Globe and Mail newspaper and website.

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PILLARS OF CREATION

The Hubble Space Telescope takes a sharper and wider view of the dramatic vista it first imaged in 1994



Although the Hubble Space Telescope has taken many breathtaking photos of the universe, one portrait stands out from the rest: the iconic view of the so-called Pillars of Creation. First imaged by Hubble in 1994 (see page 4), the picture revealed never-before-seen details of three giant columns of cold gas bathed in the scorching ultraviolet light from a cluster of young, massive stars in a small region of the Eagle Nebula (M16). Twenty years later, using a new-generation camera installed by space shuttle astronauts, Hubble revisited the famous pillars, providing astronomers with the more detailed view seen here. The entire region is a star-birth nebula. Stars are being born deep inside the pillars. For scale, the “head” of the top pillar at upper right is 5,000 times wider than the distance from Earth to Neptune.

COURTESY NASA/STSCI

Best of Dark Sky Preserves

In 20 years, Canada's astronomy parks have grown into a lively network of stargazing destinations

I SUSPECT YOU'LL BE BUSY FOR A LONG TIME TO COME," Saskatchewan dark-sky guru Rick Huziak told me when I interviewed him in 2011 for the first "Wilderness Astronomer" column. At the time, I joked that I'd keep writing about dark sky preserves in Canada as long as there were locales left to cover.

Since then, I've travelled to a different "astronomy park" for each issue of *SkyNews*. At some points along the way, the growth in the number of dark sky preserves has actually outpaced the rate at which I was writing about them.

Canada's network of dark sky preserves has grown from zero to nearly two dozen protected areas nationwide, thanks to a collaboration among three groups: dedicated enthusiasts across the country, numerous departments at all levels of government and the Light-Pollution Abatement Program of The Royal Astronomical Society of Canada.

While Canada's first preserve (Torrance Barrens, in Ontario) contained only a parking lot for infrastructure, today's dark sky preserves boast observatories, observing platforms, planetariums, astronomy-themed tours and hotel packages, as well as periodic events and festivals that draw thousands of people each year.

Here are a few thoughts on the top experiences in Canada's network of protected stargazing destinations.

INTERPRETATION AND INNOVATION

BEST INTERPRETIVE PROGRAM

MONT-MÉGANTIC INTERNATIONAL DARK-SKY RESERVE, QUEBEC

(RUNNER-UP: CYPRESS HILLS INTERPROVINCIAL PARK, ALBERTA/SASKATCHEWAN)

After you take a bus ride up the side of Mont Mégantic, interpreters at the summit do an impressively organized and interactive preshow outside the park's domed public observatory. As you wait for a view through the 24-inch telescope, you can kick back inside the observatory in a theatre-style seat and watch the latest astronomy documentaries on a large HD monitor. (Hungry? The park restaurant at the base of the mountain is open until 1 a.m.)

BEST INTERPRETER

BRIAN CATTO, JASPER NATIONAL PARK, ALBERTA

While many dark sky preserves in Canada are developing excellent interpretation programs, no single interpreter I've met has as much knowledge of and joy for the stories and science of the stars as Brian Catto, head interpreter at Parks Canada's Jasper Field Unit. Playful, easygoing and distinctly unnerdy, Brian is sure to take his place among the legendary storytellers of the Alberta Rockies.

BEST TOUR

SUNDOG TOURS' STARLIGHT-BY-BUS AND PLANETARIUM SHOW, JASPER NATIONAL PARK, ALBERTA

Possibly the world's only multistop astronomy bus tour, Jasper's premier tour company recently added a digital planetarium experience to its evening showcase of planets, stars and galaxies over the terrain of this UNESCO World Heritage region.



Wood Buffalo National Park

PHOTO BY PETER MCMAHON

Mont-Mégantic International Dark-Sky Reserve
PHOTO BY PETER MCMAHON



BEST SPACE-THEMED ATTRACTION

ASTROLAB SCIENCE ACTIVITY CENTRE, MONT-MÉGANTIC INTERNATIONAL DARK-SKY RESERVE, QUEBEC

By day, take in ASTROLab's world-class science centre exhibits, in-house astronomy films and onstage demonstrations. By night, ASTROLab staff at the base of Mont-Mégantic present TEDx-level preshows on everything from the latest exoplanets to constellation lore from around the world. Staff members then head outside to roll out a trio of high-end reflecting and refracting telescopes set up on wheeled rigs with shock-absorbing tires, and the observing session begins.

BEST NEW INITIATIVE

EVENING TOURS OF THE HOPEWELL ROCKS, NEAR FUNDY DARK SKY PRESERVE, NEW BRUNSWICK (RUNNER-UP: IMAGE-STABILIZED BINOC- ULAR TOURS ON NIGHT CROSSINGS OF THE MS CHI-CHEEMAUN FERRY, BRUCE PENINSULA NATIONAL PARK, ONTARIO)

Although the park isn't officially open at night, Hopewell Rocks head interpreter and acclaimed photographer Kevin Snair guides a limited number of tourists down to The Rocks after dark to experience a magical time under the heavens among the arches and flowerpots of one of Canada's most iconic landscapes.

SKIES AND OBSERVING

MOST DIVERSE STARGAZING REGION BRUCE PENINSULA, ONTARIO (INCLUDES BLUEWATER, BRUCE PENIN-

SULA NATIONAL PARK/FATHOM FIVE NATIONAL MARINE PARK AND GORDON'S PARK DARK-SKY PRESERVES)

No place on Earth has so many dark sky preserves so close together (three within roughly 100 kilometres of one another). Among them is one of the darkest accessible skies in Ontario and Canada's first privately owned dark sky preserve—Gordon's Park, the only place where you can take a guided trip through the heavens while floating across a lake. In summer, local astronomers offer image-stabilized binocular tours of the region's dark skies on designated night crossings of the MS *Chi-Cheemaun* ferry.

BEST OBSERVATORY

MONT-MÉGANTIC INTERNATIONAL DARK-SKY RESERVE, QUEBEC (RUNNER-UP: CYPRESS HILLS INTERPRO- VINCIAL PARK, ALBERTA/SASKATCHEWAN)

At the summit of this mecca of *l'astronomie*, you can see Maine and Vermont by day and tour the huge observatory containing the park's 64-inch main telescope. At night, a few hundred feet down the road, you can catch views of planets and deep-sky objects above the dome sheltering the park's 24-inch telescope, which is exclusively for public use.

BEST OBSERVING SITE

MCGOWAN'S VISITOR CENTRE/ROCK CREEK CAMPGROUND, EAST BLOCK, GRASSLANDS NATIONAL PARK, SASKATCHEWAN

The flat, down-to-the-horizon terrain of Grasslands National Park and the region's dry climate keep the likelihood of cloudy

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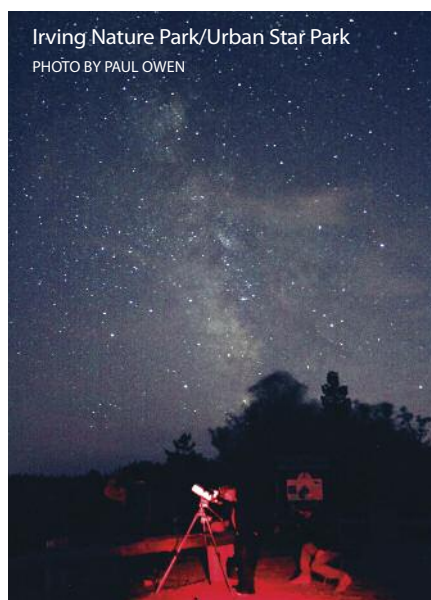
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Irving Nature Park/Urban Star Park
PHOTO BY PAUL OWEN

nights to a minimum. While any part of Grasslands is an observer's dream, the best stargazing here (and perhaps in Canada) is at the Rock Creek Campground in the park's more remote East Block. On the Bortle Dark-Sky Scale, which quantifies the brightness of a particular stargazing location, "9" is an inner-city sky, while "1" is an excellent dark-sky site. "McGowan's would be a zero," says Rick Huziak.

DARKEST SKIES

EAST BLOCK, GRASSLANDS NATIONAL PARK, SASKATCHEWAN

You'll find all the goodies associated with truly pristine skies here: high-altitude noctilucent clouds at dusk; an eerie pyramid of zodiacal light; the faint brightening from the gegenschein in the night sky opposite the Sun; and ghostly aquamarine airglow on the horizon. These phenomena are visible only from the darkest places on Earth. Can't make it to New Mexico or to Chile's Atacama Desert? A trip to this South Saskatchewan gem, just over two hours off the Trans-Canada Highway, could net you some (or all) of these views, with the bonus of a possible breathtaking aurora thrown in.

MOST ACCESSIBLE DARK SKY SITE

IRVING NATURE PARK/URBAN STAR PARK, SAINT JOHN, NEW BRUNSWICK (RUNNER-UP: ELK ISLAND NATIONAL PARK/BEAVER HILLS DARK SKY PRESERVE, NEAR EDMONTON, ALBERTA)

Perhaps the darkest and most accessible dark sky site near an urban centre is Irving Nature Park, Canada's first designated urban star park, where you can see a faint

galaxy or star cluster with the naked eye on a clear, moonless night. This dark sky preserve is just a 10-minute drive from the biggest city in New Brunswick.

MOST ACCESSIBLE DARK SKY SITE BETWEEN TORONTO AND MONTREAL

LENNOX & ADDINGTON COUNTY DARK SKY VIEWING AREA, ONTARIO

Just a half-hour drive north of Highway 401 at Napanee, Ontario, is this remarkably dark site designed for stargazers and astrophotographers. Well signed, the site is less than 100 feet off Highway 41.

ACCOMMODATION AND AMENITIES

BEST ACCOMMODATION

THE FAIRMONT JASPER PARK LODGE, ALBERTA

(RUNNER-UP: HILTON SAINT JOHN, NEAR IRVING NATURE PARK/URBAN STAR PARK, SAINT JOHN, NEW BRUNSWICK)

The home of Canada's #1 golf resort course is also the standout place to pamper yourself before or after a night of viewing the heavens. Rooms range from beautifully appointed singles to multi-thousand-square-foot log "palaces" that have hosted Queen Elizabeth II and Hollywood celebrities.

BEST ACCOMMODATION AMENITIES

THE FAIRMONT JASPER PARK LODGE, ALBERTA

The alluring scent of citrus and thyme—and fresh-baked cookies on weekends and holidays—greet you when you step into the atrium, pool and spa area. In the main lodge, you can enjoy live piano music and choose from a wide range of gastronomical delights presented by seven restaurants. Astronomy packages offer take-home tabletop telescopes, guided observing sessions and exclusive planetarium shows.

BEST DAYTIME ACTIVITIES

JASPER NATIONAL PARK, ALBERTA

In the summer months in the Jasper Rockies, between evenings of staring up at a sky full of nebulae and galactic dust lanes, try your hand at white-water rafting, scale a mountain (or take the gondola) or brave the glass floor of the thrilling Grand Canyon-style Glacier Skywalk at the Columbia Icefield. In the spring or fall,

soak up the rejuvenating waters of the local hot springs. In winter, you can hit the ski slopes or hike along a frozen riverbed at the bottom of a 100-foot-deep canyon. The local tourism authority lists 22 categories of things to do (not counting dining and shopping) in and around Jasper.

BEST DARK SKY REAL ESTATE DEVELOPMENT

DOMAINE DE LA GRANDE-ORSE, NOTRE-DAME-DES-BOIS, NEAR MONT-MÉGANTIC, QUEBEC (RUNNER-UP: SONORA RIDGE, OSOYOOS, BRITISH COLUMBIA, NEAR MT. KOBAYASHI PARTY VENUE)

Half a dozen light-pollution-friendly real estate developments are springing up among Canada's dark sky preserves. The most exciting to date is Domaine de la Grande-Orse, an astronomy-themed eco-development on the outskirts of Notre-Dame-des-Bois, on the edge of Mont-Mégantic International Dark-Sky Reserve.

FOOD

MOST UNIQUE SPACE-THEMED RESTAURANT

THE HARVEST MOON CAFE, WEST BLOCK, GRASSLANDS NATIONAL PARK, SASKATCHEWAN (RUNNER-UP: DAR'S LITTLE DIPPER, CYPRESS HILLS INTERPROVINCIAL PARK, SASKATCHEWAN)

Dig in to a locally sourced bison burger, washed down with a Prairie Sunrise mixed by amateur astronomer Caitlin Mroz at her Harvest Moon Cafe in Val Marie (pop. 96), in the slightly more populated West Block of Grasslands.

BEST OVERALL FOOD

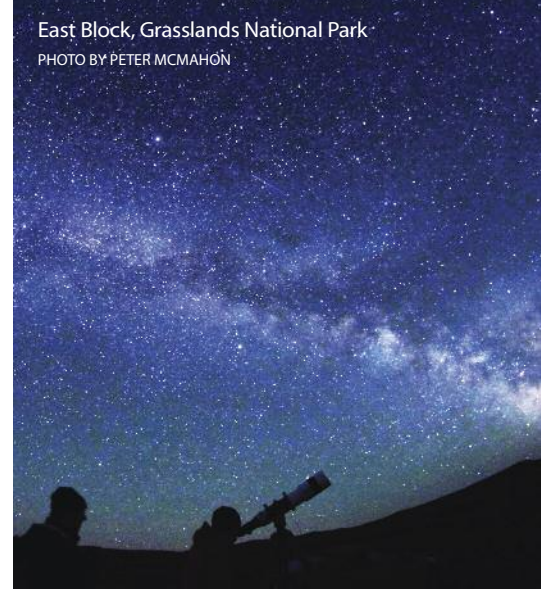
MONT-MÉGANTIC INTERNATIONAL DARK-SKY RESERVE, QUEBEC

Enjoy a memorable meal at Haut Bois Dormant or Au Vaillantbourg in Notre-Dame-des-Bois, which borders the park, where mains include veal osso bucco with beefy smoked paprika sauce and homemade linguine; fresh tagliatelle topped with rabbit confit and wild mushrooms in a creamy bay leaf sauce; and trout fillet poached in miso damari and maple syrup.

BEST RESTAURANT

AUBERGE AUX TOITS ROUGES, MONT-MÉGANTIC INTERNATIONAL DARK-SKY RESERVE, QUEBEC

Even before the stars come out, you'll think you're in heaven when you dine at this quaint inn at the edge of the park. Dinner might start with a raspberry-perfumed cream of turnip soup and a warm chicken liver salad, followed by sausage-stuffed quail and maple cream pie on a delicate thin crust. Nearly everything served here is grown or made on or near the premises. Breakfast offerings include specialty pancakes, waffles and crepes, granola parfaits with fruit and flaky fresh-baked croissants with



locally made jams and gorton (an addictive French-Canadian pork spread).

BEST DISH

ASIAN NOODLE WITH BOK CHOY AND MARINATED BBQ PORK SOUP, THE FAIRMONT JASPER PARK LODGE, ALBERTA

The Town of Jasper offers plenty of dark-sky-themed food during the annual Dark Sky Festival, but the Asian noodle soup (often known as "pho") served by executive chef Christopher Chafe at the Fairmont Jasper Park Lodge changed the way I see this Vietnamese specialty. I've had this dish in some of the top restaurants in Toronto, Vancouver and abroad, but never before have I enjoyed it more.



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Jasper National Park
PHOTO BY YUICHI TAKASAKA

THE BIG PICTURE

BEST HOSPITALITY

WOOD BUFFALO NATIONAL PARK, NORTHWEST TERRITORIES/ALBERTA

Call ahead to plan your trip with local Parks Canada staff. From the moment you arrive in the main settlement of Fort Smith, N.W.T. (population 2,500), you'll feel welcome beyond measure in the world's largest dark sky preserve. While wildlife and aurora/stargazing tourism are on the rise here, visitors are never taken for granted in this dark sky park the size of Switzerland. Wood Buffalo's visitor numbers—fewer than 5,000 each year—allow the locals to get to know tourists by name.

MOST DIVERSE OBSERVING SITES

JASPER NATIONAL PARK, ALBERTA

This park boasts 11,000 square kilometres of mountains, canyons, waterfalls, glaciers and hot springs. You could spend months in this dark sky preserve and never check out all the observing sites, tours, events and space-themed experiences on offer. When the skies are clear, you can go stargazing on an island one night, on the frozen surface of the world's only drive-up ice field the next night and in a mountain-bordered field of grass wide enough for a plane to land the following night.

BEST SINGLE EXPERIENCE

VIEWING NORTHERN LIGHTS AT WOOD BUFFALO NATIONAL PARK, NORTHWEST TERRITORIES/ALBERTA

Every clear night I've been in this dark sky

preserve, jaw-dropping displays of all-sky auroras have undulated overhead in thick bands of green, red, purple and blue. Watching the sky show in this special place, you begin to realize that you are looking at a piece of the Sun—a nuclear furnace a million times the size of our planet—reaching out across 150 million kilometres of space to tickle the Earth's atmosphere 100 or so kilometres overhead. This is the closest any of us will ever get to “touching” a star.

BEST OVERALL EXPERIENCE

JASPER NATIONAL PARK, ALBERTA

Years ago, I dubbed Jasper National Park the Disney World of astronomy parks. More than any other dark sky preserve in the world, this place truly has it all: world-class accommodations, dining, shopping, daytime tours and athletic pursuits on the terrain of a UNESCO World Heritage Site, not to mention more observing sites (two dozen distinct regions and hundreds of individual sites by my count) than any other park on Earth. What's more, the area to the south of the Town of Jasper, along the Icefields Parkway, safeguards some of the darkest skies in Canada.

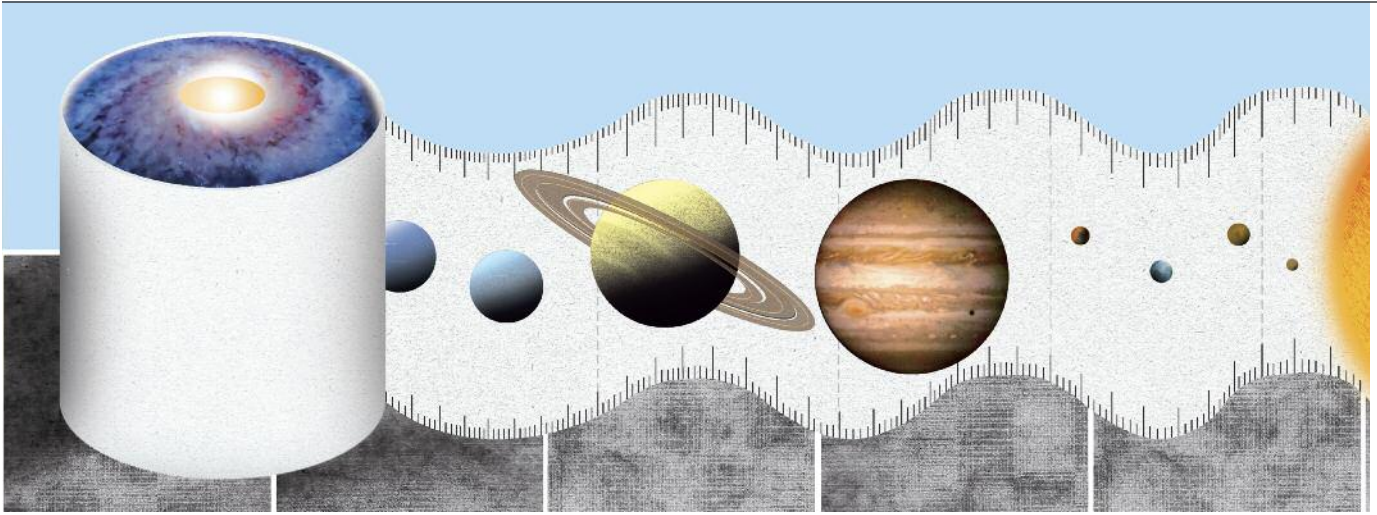
BEST ANNUAL EVENT

JASPER DARK SKY FESTIVAL, ALBERTA

(RUNNER-UP: POPULAR ASTRONOMY FESTIVAL AND PERSEID METEOR SHOWER VIEWING AT MONT-MÉGANTIC INTERNATIONAL DARK-SKY RESERVE, QUEBEC)

David Levy, Jay Ingram, Bob McDonald, *SkyNews* associate editor Alan Dyer and Canadian astronaut and “orbital guitarist” Chris Hadfield (along with yours truly) are among those who have headlined at what has become the highest-profile astronomy event of the year for discriminating amateur astronomers and casual polar-fleece skygazers alike. Featuring such populist activities as night-vision art installations, a birthday party for the MOST satellite—Canada's first space telescope—and concerts inspired by David Bowie's “Space Oddity,” this festival draws wilderness skygazers from all walks of life to a celebration of the night. ♦

For more photos from Wood Buffalo, results of the AuroraMAX project and links to the tourist amenities and events mentioned in this column, go to WildernessAstronomy.com and click on “Magazine.”



BATHROOM-TISSUE UNIVERSE

The next time you look at a roll of bathroom tissue, you, too, may be inspired to think about the universe

by Terence Dickinson Illustration by Liam Bardsley

ONE DAY NOT LONG AGO, I found myself lost in thought, contemplating the universe, when my gaze fixed on the roll of bathroom tissue on the shelf beside me. “More than 400 sheets,” the label proclaimed.

Four hundred is a popular number in astronomy. The distance to the Sun is 400 times the distance to the Moon. So if you were to unroll the entire roll of bathroom tissue, the length of one tissue would represent the distance from Earth to the Moon and the whole roll would be the span from Earth to the Sun. Along the way, we would pass Venus at around tissue number 135 and Mercury at tissue number 260.

Inspired, I unrolled the complete roll. At 424 sheets, I realized that this was also a perfect interstellar measuring tape. In 1994, the European Space Agency’s Hipparcos satellite precisely measured the distance to Proxima Centauri, the nearest star to the Sun. At 4.22 light-years, Proxima is two-tenths of a light-year closer than Alpha Centauri, a famous bright star visible from the southern hemisphere. (Despite being the nearest star beyond the Sun, Proxima is too faint to be visible from Earth without a telescope.)

If we assign a distance of one one-hundredth of a light-year to the length of a single sheet of tissue, the whole roll is almost exactly the correct length to reach Proxima. If the Sun is a dot marked at the beginning edge of the first sheet, then Neptune, the most distant planet, is about 5 millimetres away. Voyager 2, launched way back in 1977 and the most remote spacecraft from Earth, is a bit more than 22 millimetres from the Sun. It will reach the other side of the first tissue in the year 2181.

Suppose we increase the scale by 100. Now one sheet equals one

light-year. Proxima Centauri is on tissue number 5. At the end of the roll is Polaris, the North Star, slightly more than 400 light-years from the Sun (and Earth).

Increasing the scale by 10 this time, one sheet now equals 10 light-years. Proxima Centauri is less than halfway along the first sheet of tissue. At the end of the roll, 4,000 light-years distant, is the next spiral arm of the Milky Way, our home galaxy. You can see this spiral arm every summer as the glowing band of the Milky Way.

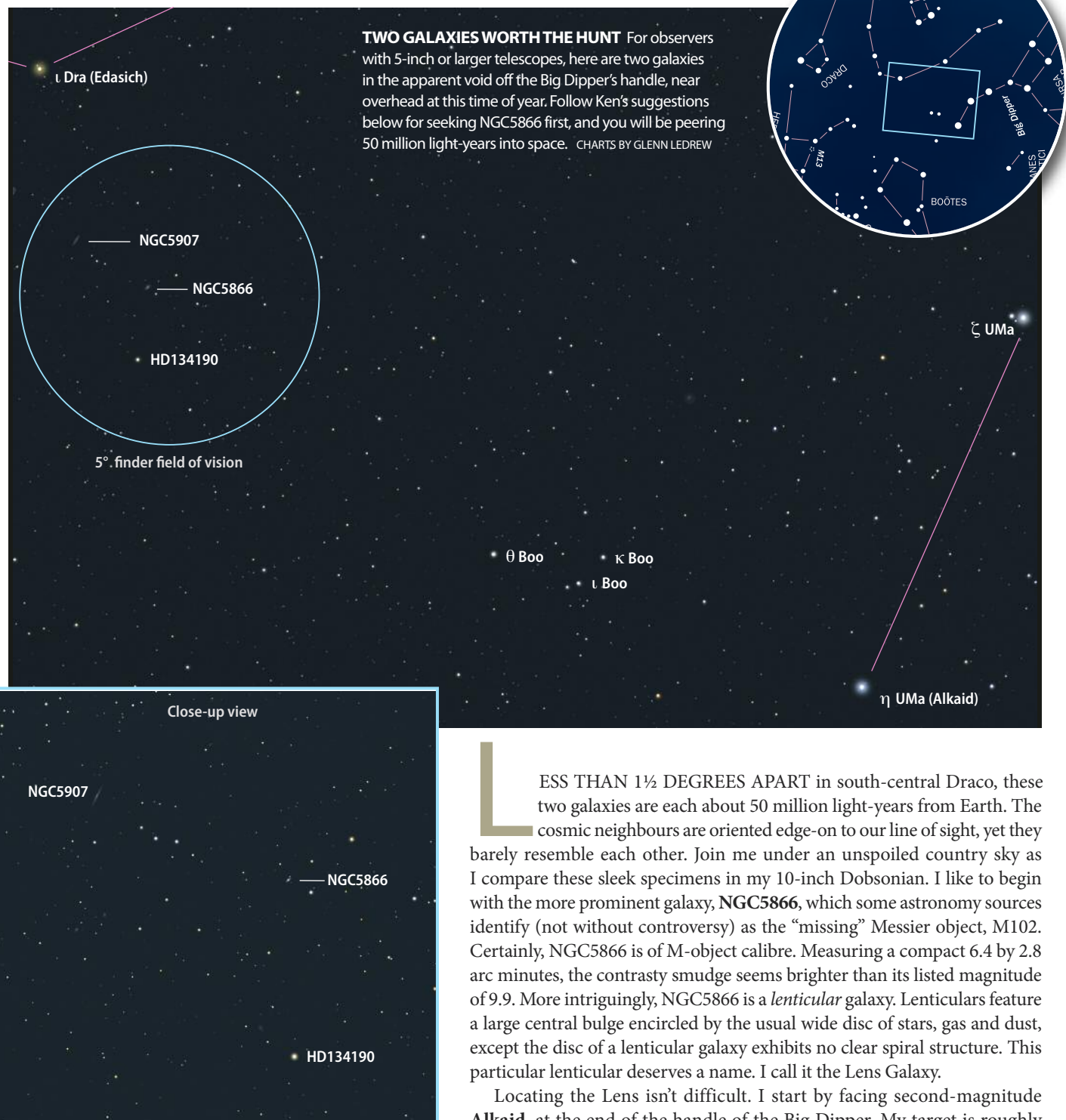
We’re not through yet. Let’s make the length of each tissue 100,000 light-years. Now the entire 90,000-light-year-wide Milky Way fits on one tissue. The Andromeda Galaxy, the nearest large galaxy similar to the Milky Way, is on tissue number 24. At the end of the roll is M87, the central giant galaxy in the Virgo supercluster of galaxies. At 45 million light-years from us, it is the nearest supercluster. This supercluster is so big that the Milky Way and Andromeda Galaxies are all considered part of it.

One final expansion: Each tissue sheet is now 30 million light-years long, big enough to hold most of the Virgo supercluster—10,000 galaxies in total. At the end of the roll are the most distant galaxies known, 12 billion to 13 billion light-years from our solar system. We can’t go much farther because we encounter the energy wall emitted long, long ago by the Big Bang creation of the universe. But that’s for another contemplative moment. ♦

Since its first appearance in SkyNews in 1998, this essay has become our most-requested article. Teachers, in particular, have found that it is a hit with students. SkyNews editor Terence Dickinson has updated the content and waived copyright. It can be photocopied in any quantity.

THE LENS AND THE SPLINTER

Eager for some late-spring galaxy hunting? Consider NGC5866 and NGC5907 in the circumpolar sky. by Ken Hewitt-White



LESS THAN 1½ DEGREES APART in south-central Draco, these two galaxies are each about 50 million light-years from Earth. The cosmic neighbours are oriented edge-on to our line of sight, yet they barely resemble each other. Join me under an unspoiled country sky as I compare these sleek specimens in my 10-inch Dobsonian. I like to begin with the more prominent galaxy, **NGC5866**, which some astronomy sources identify (not without controversy) as the “missing” Messier object, M102. Certainly, NGC5866 is of M-object calibre. Measuring a compact 6.4 by 2.8 arc minutes, the contrasty smudge seems brighter than its listed magnitude of 9.9. More intriguingly, NGC5866 is a *lenticular* galaxy. Lenticulars feature a large central bulge encircled by the usual wide disc of stars, gas and dust, except the disc of a lenticular galaxy exhibits no clear spiral structure. This particular lenticular deserves a name. I call it the Lens Galaxy.

Locating the Lens isn't difficult. I start by facing second-magnitude **Alkaid**, at the end of the handle of the Big Dipper. My target is roughly

three-quarters of the way from Alkaid to third-magnitude iota (i) Draconis, or **Edasich**, 17 degrees to the northeast. If you peruse the chart on the facing page, you'll see that I star-hop from Alkaid through a shallow triangle of fourth- and fifth-magnitude stars in northern Boötes, then continue onward into Draco to a solitary 5.2-magnitude star called HD 134190 that lies five degrees southwest of Edasich. I insert a low-power eyepiece in my scope, centre the star in the field of view, then nudge northward 1.2 degrees to claim my prize.

Viewed at 58x in my 10-inch, the Lens Galaxy is a tiny, bright ellipse. An 11th-magnitude star shines just off the western tip, and a 12th-magnitude star flickers southwest of centre. At 200x, the diffuse mass is much more substantial and brightens gradually toward a big central bulge. I can trace a hairline dust lane along that broad middle, but to my eye, it doesn't cut the core exactly in half. I perceive more haze north of the "hairline" than south of it. I admit, though, that images show NGC5866 is

perfectly edge-on. Finally, I sense that the east end of the disc fades smoothly, while the west end fades abruptly. This perceived asymmetry shows in photos.

Reverting to low power, I shift east-northeastward almost one degree to a trio of eighth-magnitude stars forming a bent line $\frac{1}{4}$ degree long. Extending that line its own length allows me to sweep up **NGC5907**, often called the Splinter Galaxy. Unlike NGC5866, this edge-on spiral galaxy appears fainter than its official magnitude of 10.3. This is partly because the Splinter, as its evocative name suggests, is wafer-thin. In fact, NGC5907's dimensions—nearly 12.9 arc minutes long and only 1.3 arc minutes wide—make this object a *flat* galaxy. These ultraslender systems feature sprawling spiral discs but vanishingly small central bulges. To join the flat-galaxy club, a candidate's profile must be at least seven times longer than it is wide. Sporting a ratio of nearly 10:1, the Splinter Galaxy definitely qualifies.

At 58x, the Splinter is a pale sliver, slant-

ing almost parallel to the nearby Lens Galaxy, with a tiny, bright glow at its core. It's easy to interpret that concentrated light as evidence of a central bulge; indeed, at 82x, the effect is stronger. But at 200x, the real Splinter emerges: a wispy, threadlike haze just marginally thicker toward the middle. The hub is hidden in the haze. The southeast half of the disc fades more evenly than the opposite half. The long eastern edge is fairly sharply defined, the western edge less so. Images of NGC5907 show a thick, grainy dust lane running west of centre along the flank, which looks fuzzy in the eyepiece. So NGC5907 isn't *precisely* edge-on.

The delicate Splinter is best observed away from city lights. An ideal time to catch both galaxies is the middle two weeks of May, when the target area is high overhead around midnight and there's no moonlight to spoil the view. Happy hunting! ♦

Contributing editor Ken Hewitt-White has observed deep-sky fuzzies over southern British Columbia for more than four decades.

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OUR CHART SHOWS the major stars, planets and constellations visible from Canada and the northern United States within one hour of these times:

EARLY MAY: 11:30 P.M.; LATE MAY: 11 P.M.
EARLY JUNE: 10 P.M.; LATE JUNE: 9 P.M.

THE EDGE OF THE CHART represents the horizon; the overhead point is at centre. On a moonless night in the country, you will see more stars than are shown here; deep in the city, you will see fewer. The ecliptic is the celestial pathway of the Moon and planets. The star groups straddling this line are known as the zodiac constellations. The Moon is shown for selected dates.

USING THE STAR CHART OUTDOORS: The chart is most effective when you use about one-quarter of it at a time, which roughly equals a comfortable field of view in a given direction. Outdoors, match the horizon compass direction on the chart with the actual direction you are facing. Don't be confused by the east and west points on the chart lying opposite their location on a map of the Earth. When the chart is held up to match the sky, with the direction you are facing at the bottom, the chart directions match the compass points. For best results when reading the chart outdoors, use a small flashlight heavily dimmed with red plastic or layers of brown paper. Unfiltered lights greatly reduce night-vision sensitivity.

CELESTIAL CALENDAR

MAY 3 Full Moon, 11:42 p.m., EDT

MAY 4 Waning gibbous Moon 5° from Saturn in late-evening sky

MAY 5 Eta Aquarid meteor shower peaks (bright moonlit sky)

MAY 6 ☿ Mercury at greatest angle away from Sun (21°) in evening sky

MAY 11 Last-quarter Moon

MAY 18 New Moon, 12:13 a.m., EDT

MAY 19 Thin waxing crescent Moon 12° from Mercury low in evening sky

MAY 21 Waxing Moon 9° from Venus in evening sky

MAY 22 Saturn at opposition (rises at sunset, sets at sunrise)

MAY 23 Waxing Moon 4° below Jupiter in evening sky

MAY 25 First-quarter Moon

MAY 27 ☿ Double-shadow transit on Jupiter, best from eastern Canada (10:01 p.m. to 12:18 a.m., EDT)

JUNE 1 Nearly full Moon 5° from Saturn in evening sky

JUNE 2 Full Moon, 12:19 p.m., EDT

JUNE 3 ☿ Double-shadow transit on Jupiter, best from western Canada (10:58 p.m. to 12:13 a.m., MDT)

JUNE 6 Venus at greatest angle away from Sun (45°) in evening sky

JUNE 9 Last-quarter Moon

JUNE 11 Asteroid 2 Pallas at opposition in Hercules (brightest for 2015)

JUNE 12 ☿ Venus ½° from Beehive star cluster, M44, low in west; Neptune begins retrograde motion 2° west of lambda Aquarii

JUNE 16 New Moon, 10:05 a.m., EDT

JUNE 19 Waxing crescent Moon 6° from Venus in evening sky

JUNE 20 Waxing crescent Moon 5° from Jupiter in evening sky

JUNE 21 Solstice, 12:38 p.m., EDT (summer officially begins in the northern hemisphere)

JUNE 24 First-quarter Moon

JUNE 30 ☿ Venus and Jupiter just 0.3° apart low in evening sky

☿ Impressive or relatively rare astronomical event

THE PLANETS

MERCURY reaches its greatest elongation east of the Sun (placing it as high as it gets in our western evening sky) on the evening of May 6 for North America. Look for it as a first-magnitude star low in the west.

VENUS continues to dominate our spring evening sky, brightening from magnitude -4.2 on May 1 to an even more impressive -4.6 by the end of June. It reaches its greatest elongation east of the Sun on June 6. On June 12 and 13, Venus passes ½° above the Beehive star cluster. On June 30, Venus appears just 0.3° from bright Jupiter.

MARS can be sighted with difficulty in early May as a 1.5-magnitude object very low in the evening twilight. Mars soon drops too close to the Sun to see for the rest of the spring and most of the summer.

JUPITER shines brightly in Cancer in the western sky above Venus. It dims slightly from magnitude -2.1 in early May to -1.8 in late June. Through the spring, Jupiter drops closer to the horizon, meeting up with Venus for a very close conjunction on June 30.

SATURN reaches opposition on May 22, when it lies directly opposite the Sun and rises in the southeast in Scorpius as the Sun sets in the northwest. Look for the Moon near Saturn as both rise together on May 4 and a month later on June 1.

URANUS begins to reappear in the predawn sky at the end of June as a 5.9-magnitude object just ½° below the fifth-magnitude star zeta Piscium.

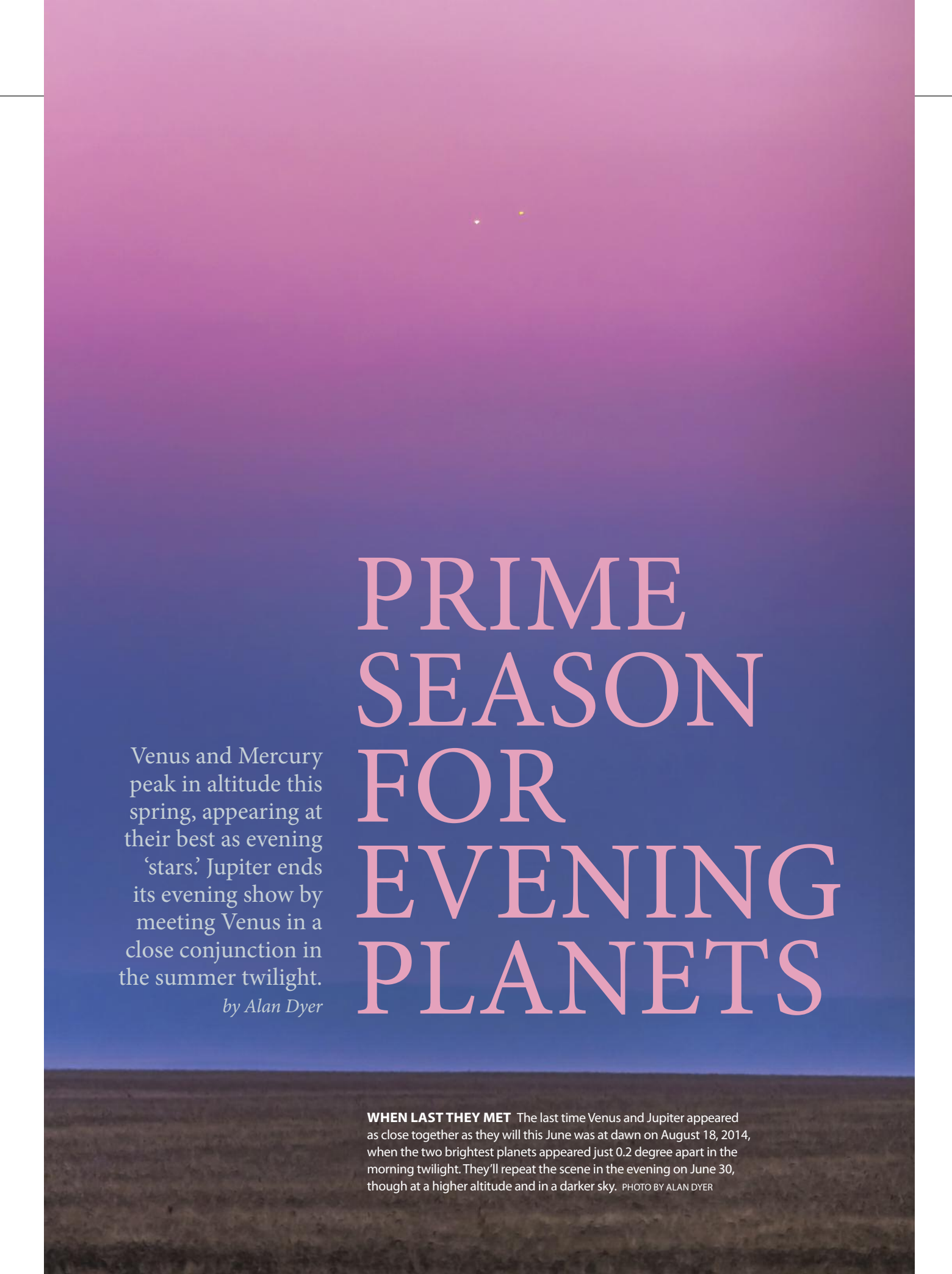
NEPTUNE can be sighted in the predawn sky as a 7.9-magnitude bluish "star" about 2° west of the fourth-magnitude star lambda Aquarii. Neptune begins its annual retrograde motion on June 12.

Cartography and design by Roberta Cooke.
 Base chart data derived from maps drawn by Roy Bishop for the *Observer's Handbook*, published by The Royal Astronomical Society of Canada.



ROTATING NIGHT SKY: During the night, the Earth's rotation on its axis slowly shifts the entire sky. This is the same motion that swings the Sun on its daily east-to-west trek. The rotational hub is Polaris, the North Star, located almost exactly above the Earth's North Pole. Everything majestically marches counter-clockwise around it, a motion that becomes evident after about half an hour.

CONSTELLATIONS: The star groups linked by lines are the constellations created by our ancestors thousands of years ago as a way of mapping the night sky. Modern astronomers still use the traditional names, which give today's stargazers a permanent link to the sky myths and legends of the past.



Venus and Mercury peak in altitude this spring, appearing at their best as evening 'stars.' Jupiter ends its evening show by meeting Venus in a close conjunction in the summer twilight.

by Alan Dyer

PRIME SEASON FOR EVENING PLANETS

WHEN LAST THEY MET The last time Venus and Jupiter appeared as close together as they will this June was at dawn on August 18, 2014, when the two brightest planets appeared just 0.2 degree apart in the morning twilight. They'll repeat the scene in the evening on June 30, though at a higher altitude and in a darker sky. PHOTO BY ALAN DYER

CELEBRATE SPRING WITH A PLANET FEST! With the lone exception of Mars, all the naked-eye planets put on a show this season.

Mercury rises to its best evening apparition of 2015. Venus shines higher and brighter than we've seen it in three years. Jupiter joins Venus for a fine close conjunction and presents two opportunities for sighting dual moon shadows on its cloudtops. That's all in the early-evening sky.

Meanwhile, in the late-night sky, Saturn shines at its brightest and closest for 2015, with its rings in spectacular display.

The large asteroid Pallas makes up for the lack of Mars, providing an additional solar system target looping in the unlikely location of Hercules, high in our spring sky.

EVENING 'STAR' #1: MERCURY

While the inner planet is truly mercurial—elusive and fast-changing—it is certainly not unpredictable. We can say with precision that Mercury reaches its greatest angle away from the Sun on May 7 at 1 a.m., EDT. At that time, it sits 21 degrees east of the Sun, placing it in our western evening sky, where it sets as much as two hours after the Sun.

Although May 7 is the official date of “greatest elongation,” I’ve listed it as May 6 because from our longitude, Mercury is at its highest and best for 2015 on that evening.

During the prime evening viewing period—a week on either side of May 6—look for a first-magnitude “star” shining in the twilight in the hour after sunset. Mercury can be found a binocular field to the right, or north, of Aldebaran above the Pleiades star cluster.

A day or two on either side of the elongation date won't make a huge difference, but a week? That's when Mercury's namesake trait comes into play. Mercury drops back toward the Sun very rapidly in May, and by Victoria Day (May 18 for non-Canadians reading this), it will be too low to spot easily.

Mercury will disappear quickly from our evening sky to reappear in the dawn sky in June as a morning “star.” It will reach its greatest elongation west of the Sun in the eastern sky on June 24. But this will be a poor morning appearance for Canadian latitudes, with Mercury low and lost in the twilight. From Canada, we won't see Mercury well again until October, during its most favourable morning appearance of 2015 for northern latitudes.

As I've said many times in these pages, use binoculars first to find Mercury amid the twilight. Once you locate it, you'll be amazed at how bright and obvious Mercury is to the unaided eye, making you wonder how this planet garnered its reputation for being so hard to find. There it is!



PLANET ARRAY IN MAY The waxing crescent Moon performs wide passages by three evening planets in May: far to the left of Mercury on May 19; well below Venus on May 20 and to the left of the planet on May 21; then below Jupiter on May 22 and 23. Look for Earthshine lighting the dark night-side of the Moon. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.



PLANET AND STAR PAIRINGS As May begins, Mercury can be seen climbing into the sky and passing the Pleiades star cluster low in the northwest. Meanwhile, Venus is passing the first-magnitude star Elnath, a.k.a. beta Tauri, a star shared with Auriga the charioteer. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.

MERCURY AND VENUS AT THEIR HIGHEST Mercury reaches its greatest angle away from the Sun on May 6, in its best appearance of the year in our Canadian evening sky. Also in early May, Venus appears as high above the horizon as it gets this spring from Canada, allowing it to remain prominent in the northwestern sky until as late as midnight.

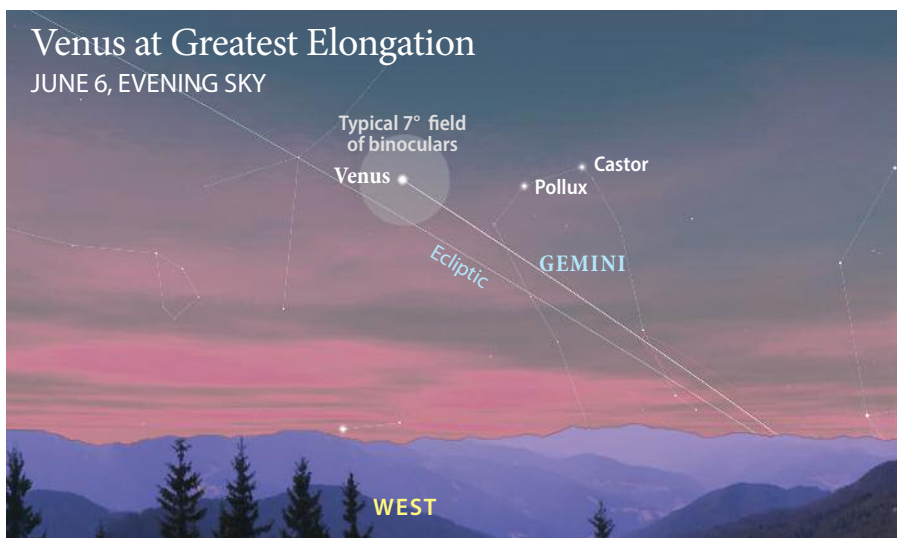
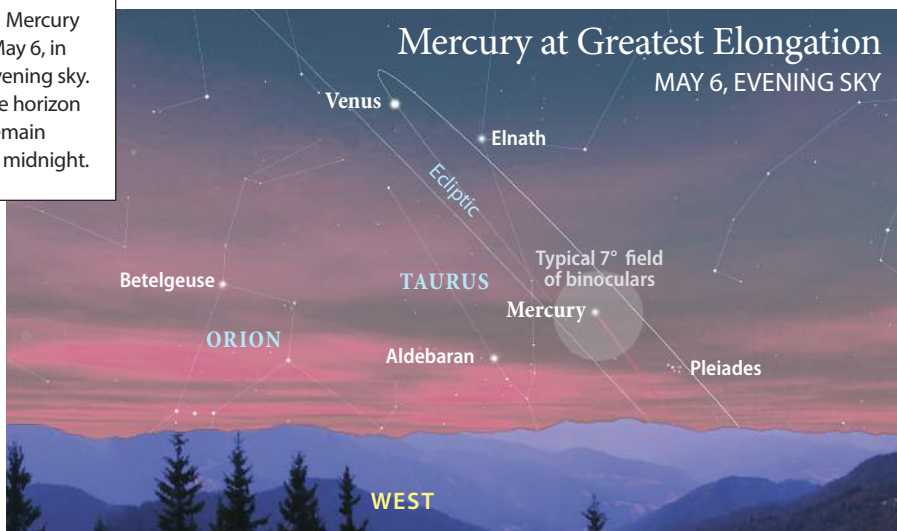
EVENING 'STAR' #2: VENUS

While it takes a little effort and good timing to see Mercury, Venus is, by contrast, “in-your-face” obvious this spring. Indeed, you have likely been enjoying its rise to brilliance all winter and early spring. This year, we are treated to one of the best evening appearances of Venus in several years, certainly since spring 2012.

Venus swings away from the Sun in May and early June, reaching its greatest angular separation from the Sun, at 45 degrees, on June 6. And yet in Canada, we'll see Venus at its highest above the horizon a month earlier, in early to mid-May. Despite Venus's increasing distance from the Sun in May, the dropping angle of the ecliptic in late May and June wins out, swinging Venus lower as the season progresses.

This effect is more pronounced at northern latitudes. As viewed from the southern United States, Venus remains high in the west until well into June, past its greatest elongation date.

No matter where you are, you'll see Venus get brighter throughout the spring, from magnitude -4.2 in early May to -4.6 by the end of June. It will peak in brilliance on July 9, at magnitude -4.7 , when its growing disc size and shrinking crescent phase conspire to make Venus even brighter than



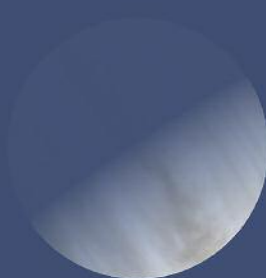
VENUS FARTHEST FROM THE SUN A month after Mercury's greatest elongation from the Sun, Venus reaches the same position in its orbit. By June, however, the declining tilt of the ecliptic actually swings Venus lower in the sky than it was in early May, despite the planet's greater angular separation from the Sun. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP. (BOTH)

VENUS WANES BUT GROWS Follow Venus through a telescope this spring, and you'll see the cloud-shrouded planet double in disc size, from 16 to 32 arc seconds across. At the same time, its phase wanes from gibbous to a wide crescent as the planet swings around its orbit and starts to move between Earth and the Sun. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP. (ALL)

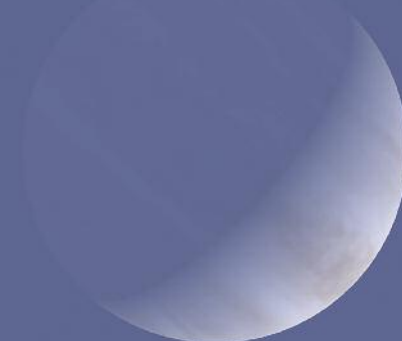
Venus at Gibbous Phase
MAY 1: 16.7 ARC SECONDS



Venus at Half Phase
JUNE 1: 22.1 ARC SECONDS

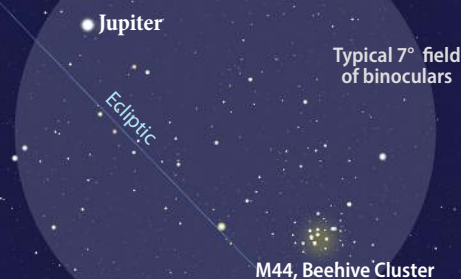


Venus at Crescent Phase
JULY 1: 32.3 ARC SECONDS



Jupiter Near Beehive

EARLY MAY, EVENING SKY



JUPITER BESIDE THE BEEHIVE In early May, binoculars will frame Jupiter six degrees to the east of the Beehive star cluster, Messier 44, as both shine high in the west. But Jupiter pulls away from M44 over the spring as its orbital motion takes it eastward among the stars.

it normally appears—by far the brightest celestial object apart from the Moon.

EVENING 'STAR' #3: JUPITER

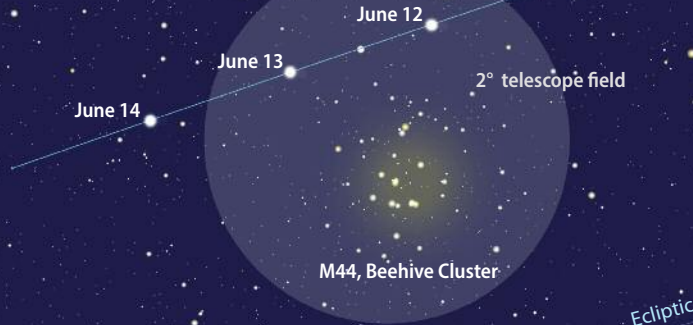
While Jupiter dominated the eastern and southern evening sky all spring, it is now in the west at nightfall. Second only to Venus

in brightness, Jupiter shines at magnitude -2.1 , dimming slightly to magnitude -1.8 by the time it meets Venus on June 30.

After having passed Jupiter in early February, when it was at opposition and brightest for 2015, we are now receding from the giant planet. Nevertheless, it will still afford

Venus Passes Beehive

JUNE 11-14, EVENING SKY



EVENING 'STAR' IN M44 Venus passes just $\frac{1}{2}$ degree north of the Beehive star cluster on June 12 and 13. The sky will be bright with summer twilight, but the cluster should still stand out in a telescope. Use low power to frame Venus and the cluster. COURTESY THESKYX™/SOFTWARE BISQUE (BOTH)

us some fine telescope views this spring, the last we'll get of Jupiter in the evening sky for the year.

As May begins, look for Jupiter shining a binocular field (six degrees) east of the Beehive star cluster, Messier 44. Through spring, you'll see Jupiter slowly pull away from M44 as the big planet's prograde orbital motion takes it farther east each night. By July 1, Jupiter—now paired with Venus—sits a wide 14 degrees from M44, which is lost low in the twilight.

Among the other Jovian highlights this spring are two double-shadow transit events, on May 27 and June 3. The former is best timed for viewing from eastern Canada, while the latter is best seen from western Canada, a fair and equitable national distribution of observing wealth.

CONJUNCTION OF THE YEAR

The highlight of the season is the climax of a convergence of Jupiter and Venus that has been happening all spring. On June 30, the two planets are a mere 20 arc minutes (0.3 degree) apart in arguably the best and certainly the closest naked-eye planet conjunction of the year.

Be sure to use a telescope to frame both planets at once, and note the cosmic coincidence: Venus and Jupiter appear the same size, 32 arc seconds across, despite their twelvefold difference in actual diameter. The equalizer, of course, is distance. Venus is just 76 million kilometres away on June 30, approaching Earth on our side of the Sun. Jupiter, however, lies on the other side of the Sun, some 900 million kilometres away.

JUPITER'S MOONS

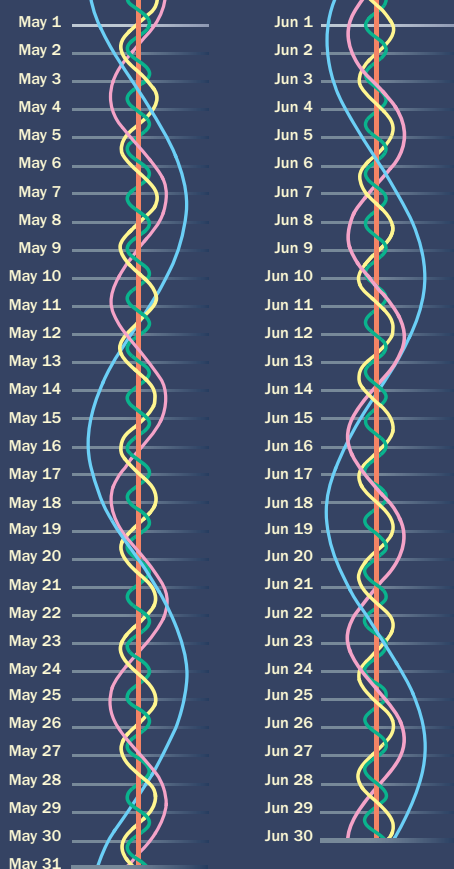
May and June 2015

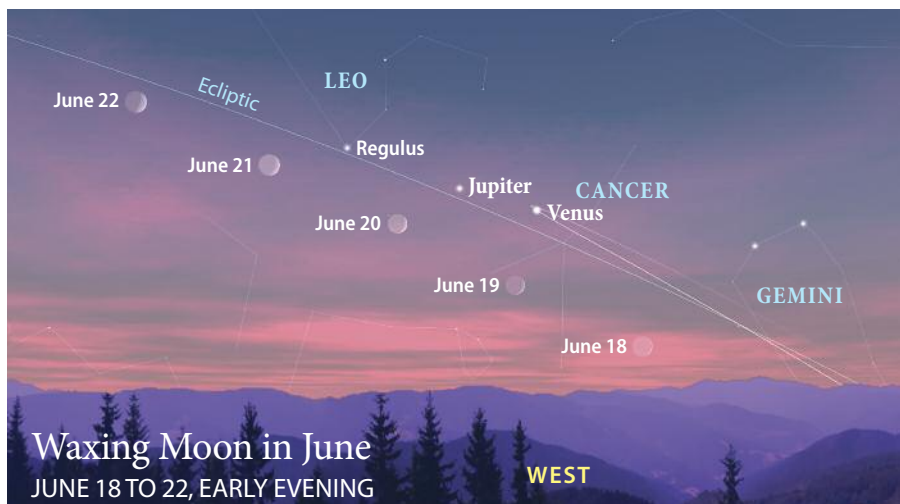


The positions of Jupiter's four largest moons are shown for each night of the two-month period. Jupiter is represented by the central vertical shaft, while the moons are the four wavy lines. The horizontal lines mark 8 p.m., EDT, on the dates indicated. Time flows from top to bottom, so look proportionately below the line for later times on a particular date. East is to the left, and north is at the top, as seen in binoculars. From closest to farthest, the moons are Io, Europa, Ganymede and Callisto. Orbital periods are 1.8, 3.6, 7.2 and 16.7 days, respectively.

KEY:

Io Europa Ganymede Callisto





LUNAR PASSAGES IN JUNE When the Moon returns to the evening sky in late June, Venus and Jupiter are converging toward their June 30 conjunction. The crescent Moon shines a wide six degrees below Venus on June 19 and five degrees below Jupiter on June 20. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.

To see this conjunction, find a location with a clear view toward the western horizon. From Canadian latitudes, certainly north of 50 degrees, the two planets appear in a twilight sky, despite their setting as late as midnight. From more southerly latitudes, however, the pairing appears higher. While Jupiter and Venus set earlier than they do as viewed from up north, so does the Sun, placing the brilliant duo in a dark sky from southern Ontario and most U.S. latitudes.

Astrophotographers will be out in force for this event, shooting the planets shining above all manner of creative and scenic settings. What's more, the planets will still appear very close together (40 arc minutes apart) the next night, Canada Day. We'll no doubt see some impressive shots of the twin planets shining from behind celebratory fireworks.

A PAIR OF DOUBLE-SHADOW TRANSITS

As Jupiter sinks into the western twilight, it presents Canadian observers with two nights for witnessing a pair of moon shadows cast onto the planet at once. The first event is timed best for eastern Canada, the second for western Canada. In both cases, the moons Ganymede and Io project their dark shadows onto the cloudtops for a double-shadow transit. To see the shadows, use a 90mm-to-100mm-aperture telescope at moderate to high power. Ganymede's shadow will appear larger than Io's, but perhaps not quite as dark or as sharply defined, as it is surrounded by a large, grey penumbral shadow.

TWIN SHADOWS FOR THE EAST

The double transit begins at 10:01 p.m., EDT, on May 27, as the shadow of Io joins Ganymede's shadow on Jupiter's disc, with the responsible moons far from the disc to the west. At about 11:45 p.m., EDT, Io's shadow will merge with Ganymede's for a few minutes. The double transit ends at 12:18 a.m., when Io's shadow leaves the disc. North is up in both views.

TWIN SHADOWS FOR THE WEST

The timing of the June 3 event favours western Canada (from the east, Jupiter has set by the time the event begins). The entry of the shadow of Ganymede onto the disc at 10:58 p.m., MDT, begins the double transit, while the exit of Io's shadow at 12:13 a.m. ends the event. In this case, the two shadows never catch up to each other, as they do on May 27.

COURTESY THESKYX™/SOFTWARE BISQUE (BOTH)

Double-Shadow Transit

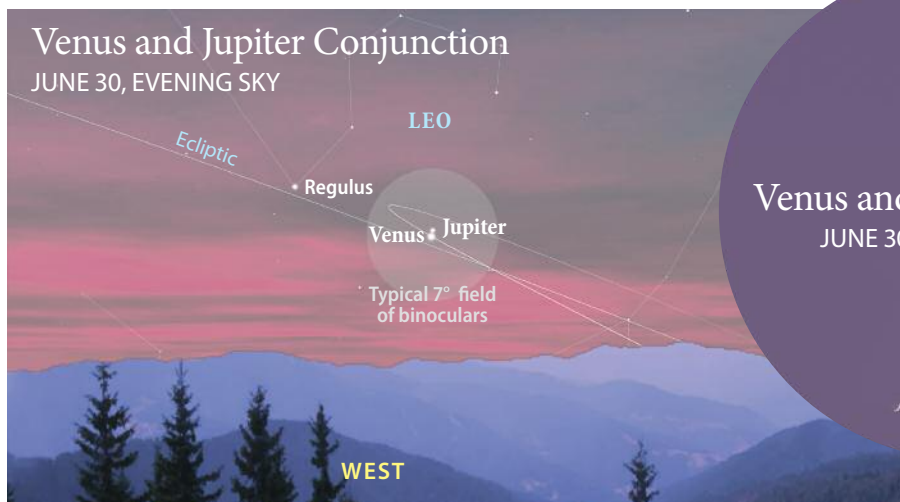
MAY 27, 10:01 P.M. TO 12:18 A.M., EDT



Double-Shadow Transit

JUNE 3, 10:58 P.M. TO 12:13 A.M., MDT





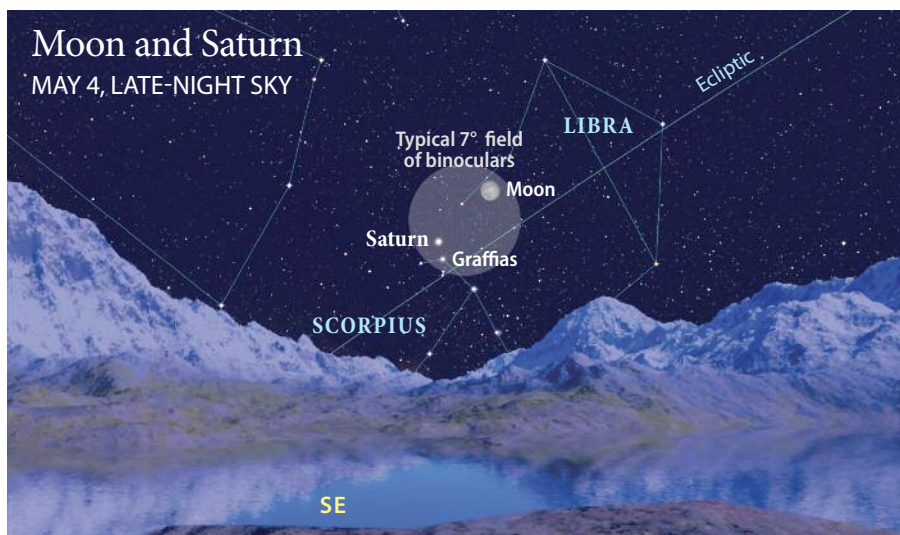
Venus and Jupiter Close-up JUNE 30, TELESCOPE VIEW

MATCHING PLANETS

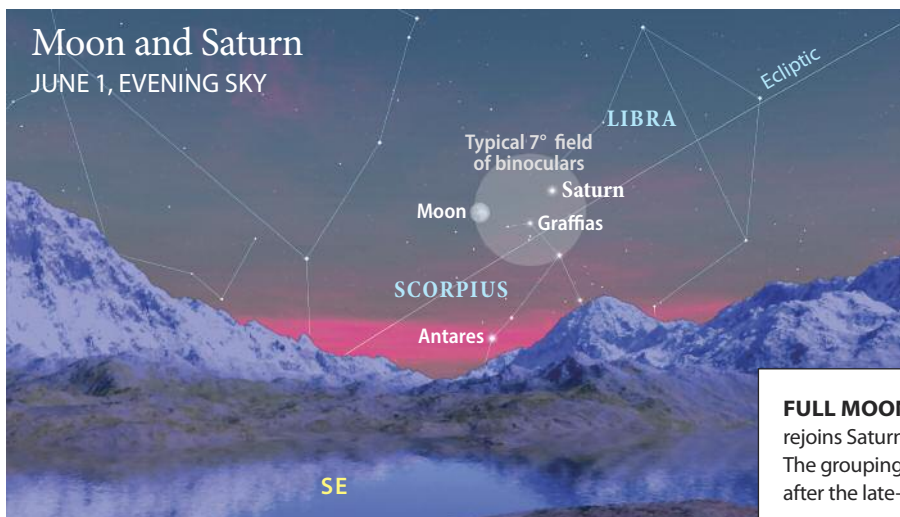
On June 30, both cloud-covered planets fit nicely inside a moderate-power telescope field. By coincidence, the two planet discs appear almost exactly the same size, at 32 arc

seconds across. Jupiter, however, is flanked by its four Galilean moons, with Ganymede to the east and Europa (closest to Jupiter), Io and Callisto equally spaced to the west. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.

0.3-DEGREE SEPARATION On June 30, Venus and Jupiter are just 0.3 degree, or 20 arc minutes, apart, shining as a bright double “star” low in the western twilight. The night before, June 29, and the night after, July 1 (Canada Day), the two worlds appear 40 arc minutes apart, still less than a degree of separation. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP.



SATURN IN SCORPIUS Saturn now shines in the head of Scorpius, near the star beta Scorpii, a.k.a. Graffias. On May 4, the waning gibbous Moon appears five degrees from the Saturn-Graffias pairing as the grouping rises during the hour before midnight.



LATE-NIGHT PLANET: SATURN

If that isn't spectacle enough, look southwest and train your telescope on the interloping “star” in northern Scorpius. That's Saturn, now at its best for the year.

Saturn reaches opposition on May 22, when Earth passes between Saturn and the Sun and the ringed world lies closest to us. Saturn is now retrograding westward among the stars above the bright star beta Scorpii, which is also known as Graffias. For an easy naked-eye observing project, watch Saturn pull away from Graffias through May and June.

But the real reward comes when you aim a telescope at the planet. If you have not seen Saturn for a while, you'll be amazed at how wide the rings currently appear, tipped 24 degrees to our line of sight. Saturnians in the planet's northern hemisphere are now enjoying late spring. In the southern hemisphere, however, Saturnians are freezing in winter, which is made even colder by the shading effect of the rings and the low angle of the Sun. We can be thankful that our planet does not have Saturn-like rings, or our Canadian winters would be even colder than they are.

Saturn's northern summer solstice arrives in May 2017, an event that happens only once a Saturnian year, every 29.5 Earth

FULL MOON BY SATURN A month later, the Moon, now full, rejoins Saturn, which has retrograded west away from Graffias. The grouping is already up in the southeast as the sky darkens after the late-hour June sunset. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP. (BOTH)

years. At that time, Saturn's northern hemisphere will be tipped at its maximum angle toward the Sun and us. The rings will then be tipped as much as 27 degrees, the maximum possible. So this year's view is not much off the maximum, giving us a stunning view of Saturn.

The downside is that from Canada, Saturn appears low in the sky, hugging the southern horizon. Like a winter Sun, Saturn rises late and sets early, affording us just a brief viewing period on our short late-spring and early-summer nights. More critically, because of Saturn's low altitude, atmospheric distortion from poor "seeing" often blurs fine details. But the effects of Saturn's low altitude can't detract entirely from the spectacle. For the best views, wait until Saturn shines due south, about 1 a.m., local time. Look for the Moon passing Saturn on the evenings of May 4 and June 1.

Saturn at Opposition

MAY 22



RESPLENDENT RINGS

Now tilted 24 degrees, the rings neatly encompass the planet itself. We are looking down on the north face of the rings, as Saturn's northern hemisphere basks in summer sunlight. Look for the dark Cassini's division that separates the A ring from the brighter, denser B ring. The C ring may be visible only as a dusky shading across the disc of the planet. Sighting the thin Encke gap in the A ring requires a 25-centimetre or larger telescope and excellent seeing conditions, which are unlikely considering Saturn's low altitude as viewed from Canada. COURTESY THESKYX™/SOFTWARE BISQUE

ASTEROID #2 AT OPPOSITION

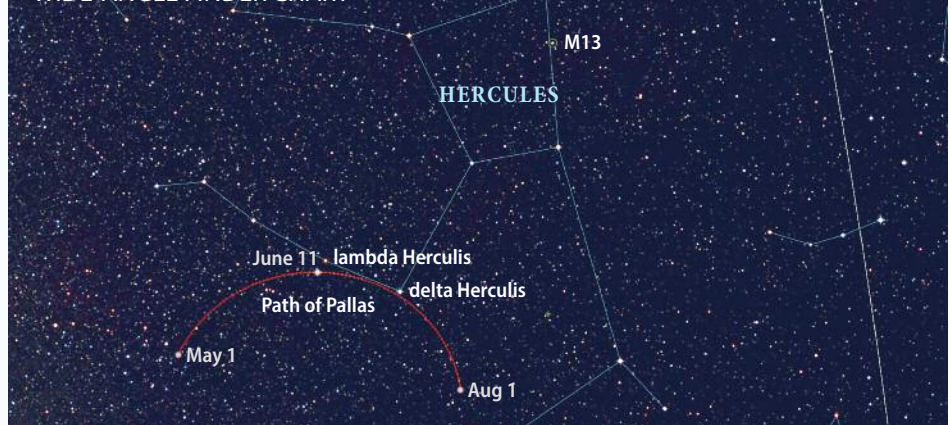
While asteroid/dwarf planet 1 Ceres gets the attention this spring because of the visit of NASA's Dawn probe, Ceres' location in southern Capricornus places it low in our Canadian predawn sky.

Instead, why not try for asteroid 2 Pallas? Discovered by Heinrich Olbers in 1802, Pallas is the second asteroid to be found, after Ceres. The 34-degree tilt of its orbit swings 500-kilometre-wide Pallas high above the ecliptic plane, where we find all the major planets. Pallas reaches opposition on June 11, when it is closest to us and brightest, while it loops through Hercules, a constellation we don't think of as home for solar system targets. Hercules' high altitude in our spring sky makes it easy to locate Pallas, which peaks at magnitude 9.4.

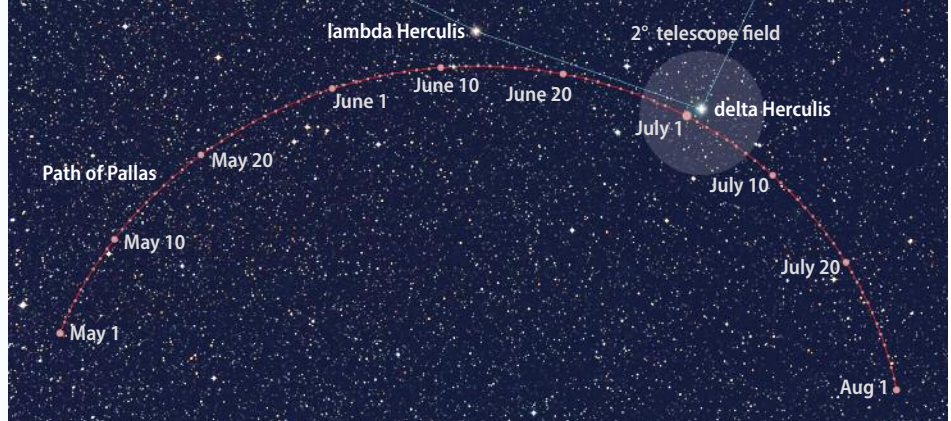
FINDING PALLAS IN HERCULES This spring and summer, 2 Pallas can be found performing an odd semicircular loop in southern Hercules. On opposition night, June 11, Pallas sits just 40 arc minutes south of the fourth-magnitude star lambda Herculis. Pallas itself will appear as a 9.4-magnitude "star."

PATH OF PALLAS On opposition night, Pallas just misses the ninth-magnitude star HIP 84845, forming a temporary "double star" with noticeably increasing separation as Pallas moves away from the star during the night. On July 2, Pallas passes 12 arc minutes south of third-magnitude delta Herculis, a.k.a. Sarin, making it easy to pick out. COURTESY STARRY NIGHT PRO PLUS™/SIMULATION CURRICULUM CORP. (BOTH)

Picking Out Pallas WIDE-ANGLE FINDER CHART



Picking Out Pallas CLOSE-UP FINDER CHART



THE CLOUDS OF SOLSTICE As summer solstice approaches, be on the watch for noctilucent clouds (NLCs) shining low in the northern sky. Commonly seen from Canadian latitudes, these icy clouds lie at the edge of space, at an altitude of about 80 kilometres, so high they can be lit all night long by the Sun. NLCs appear as strangely glowing bands across the northern horizon, as seen in this display from summer solstice night in 2014. They are very photogenic and lend themselves to time-lapse movies that reveal their slow waving motion. Be sure to send your 2015 NLC portraits to *SkyNews*. PHOTO BY ALAN DYER

At opposition on May 22, Saturn lacks any visible shadows. Sunlight is now shining directly down onto the planet. From our perspective, the shadow of the planet cast onto the rings is hidden behind the planet, while the shadows of the rings cast onto the planet are hidden behind the rings.

With the rings so wide open this year, it should be easy to spot Cassini's division, even in wobbly seeing conditions. The dark gap in the rings is created, in part, by the gravitational perturbations of Saturn's moon

Mimas sweeping that region clear of most ring particles. At 4,800 kilometres wide, Cassini's division could nicely contain all of Canada.

A more elusive feature to identify is the C, or crepe, ring, visible as a grey band across the disc of Saturn on the inside edge of the rings. Although it might look like a shadow, it's actually the sparsely populated ring silhouetted in front of the planet.

In addition, Saturn's rings shine a little brighter than usual around May 22 because

of the "opposition effect": At opposition, the myriad ice particles in the rings reflect sunlight directly back to us more effectively than when they are being illuminated at an angle. Indeed, amateur astronomers are challenged each year to see whether they can detect a surge in brightness in the rings as Saturn reaches opposition.

Check out Saturn anytime this spring and into the summer, and you'll certainly enjoy a surge in excitement at the picture-postcard view. ♦

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Background photo: B 33 Horsehead Nebula LDN 1630 by Dalton Wilson

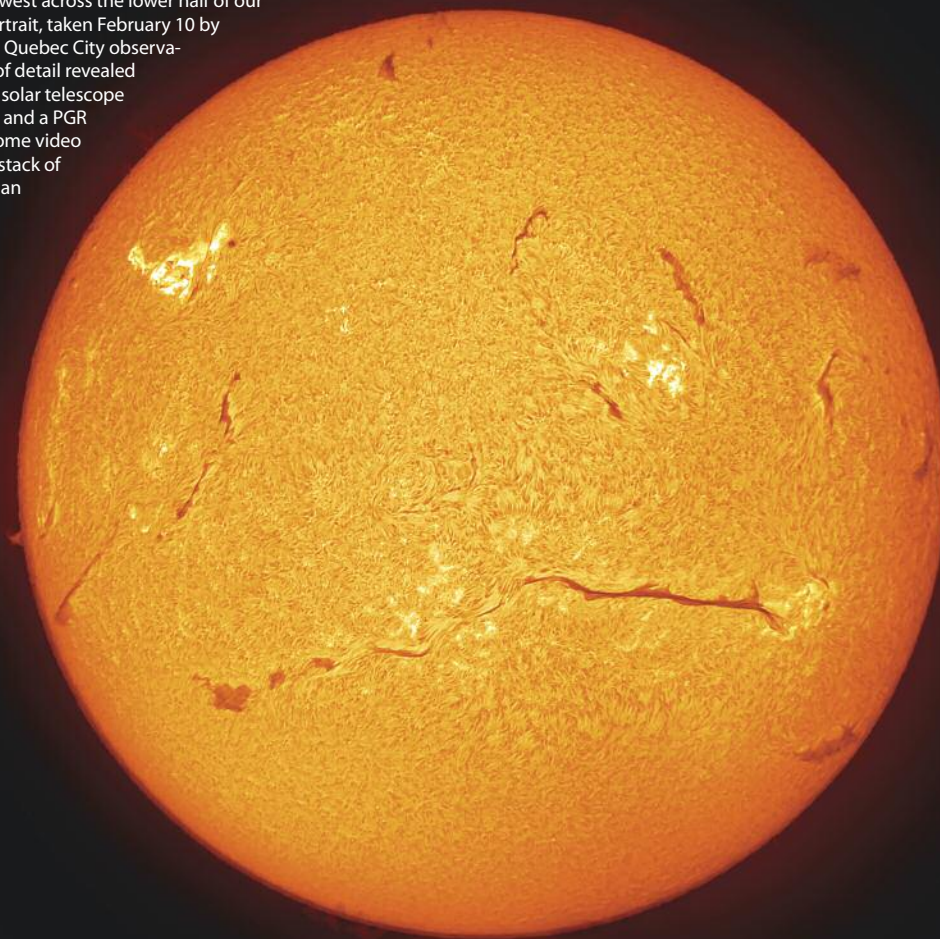
SUN DOGS & BEYOND

Astro-images of astonishing quality and ethereal beauty are submitted by our readers and proudly displayed in each issue

SOLAR PILLAR AND SUN DOGS Shane Finnigan of Ottawa writes: "I have always been fascinated with the natural sky phenomena that occur in cold or extreme weather. On January 20, I woke to discover a bright sun dog in view from my window. In this shot taken from a nearby field, the sun dogs and a sun pillar are plainly visible. In my many years of shooting sun dogs and pillars, I cannot recall seeing both together."



ACTION ON THE SUN In mid-February, a huge filament one million kilometres in length—more than twice the Earth-Moon distance—spread east-west across the lower half of our star's face. This solar portrait, taken February 10 by Jean Guimond from his Quebec City observatory, shows a plethora of detail revealed by a Lunt LS80 H-alpha solar telescope (80mm diameter at f/7) and a PGR Grasshopper monochrome video camera. The image is a stack of the best 100 of more than 1,000 frames.





▲ **ORION'S SWORD REGION** From his backyard in Coquitlam, British Columbia, Bill Batchelor took multiple images of Orion's iconic Horsehead Nebula and M42 (close to four hours of total integration) using a modified Canon T2i DSLR and a 200mm f/2.8L lens at f/4.0 and ISO 400 on a Celestron Advanced VX mount, guiding with PHD2 and utilizing BackyardEOS capture software. Batchelor then added a modest amount of Hydrogen-alpha data and detail from an earlier imaging session.



▲ **PLEIADES STAR CLUSTER, IN TAURUS** Mike Bonin of Halifax, Nova Scotia, recorded a fine portrait of the night sky's most distinctive star cluster using a filter-modified Nikon D5100 on an Explore Scientific 102mm f/7 apo refractor for a 120-minute exposure. According to the most recent calculations, this cluster is 444 light-years distant.



▲ **BRIGHT GALAXY DUO, M81 AND M82** For this stunning image of the grand design spiral galaxy M81 (left) and its smaller disturbed partner M82, Richard Bloch of Thornhill, Ontario, used a Sky-Watcher 80ED 80mm f/7.5 apo refractor and a modified Canon T3i camera on a Celestron Advanced VX mount to take 22 ten-minute exposures at ISO 1600.



► **THE GREAT ORION NEBULA** Among the most-photographed objects in the heavens, the cup-shaped Orion Nebula (M42) and its companion, the Running Man Nebula (NGC1977), are exquisitely captured in this photo by Ron Brecher of Guelph, Ontario. He used a 10-inch f/3.6 ASA astrographic reflector for the CCD image. For further details, see www.astrodoc.ca.

◀ **VENUS-MARS-MOON CONJUNCTION**

For this vibrant portrait of Venus (brightest), Mars and the crescent Moon over Quebec City on February 20, when the temperature dipped to -29°C , photographer Jay Ouellet used an Olympus OM-D E-M1, set for a five-shot High Dynamic Range (HDR) exposure, with the new Olympus 40mm to 150mm f/2.8 lens at f/3.5. The camera was mounted on an iOptron SkyTracker set at half tracking speed.

▼ **FULL MOON WAITING FOR 'E.T.'**

While on vacation at Coral Pink Sand Dunes State Park, near Kanab, Utah, Lynn Balmer of Burnaby, British Columbia, was watching the Sun set on one side and the Moon rise on the other. "It reminded me of a scene from *E.T. the Extra-Terrestrial*, but missing the bicycle riding across the Moon," she writes. For this 1/250-second shot, Balmer used a Canon 70D with a 100mm to 400mm zoom lens at 400mm, f/9 and ISO 400.





Celestron's NEXSTAR EVOLUTION

The Schmidt-Cassegrain telescope continues to evolve, adapting to the times with WiFi for control by an app *by Alan Dyer*

THE 8-INCH Schmidt-Cassegrain telescope revolutionized the hobby of astronomy 40 years ago when Celestron introduced the original orange-tube C8. Since then, the venerable telescope has kept up with the times. The latest edition adds a number of enticing features to appeal to the mobile-phone generation—indeed, to anyone now entering the hobby.

SOFTWARE AND HARDWARE REQUIREMENTS

At \$1,750, the NexStar Evolution 8 serves as a premium version of the popular \$1,250 NexStar SE. Both NexStars feature the same excellent f/10 Schmidt-Cassegrain optics, and their tripods are similar and sturdy. What's evolved is the mount.

The NexStar Evolution takes the Schmidt-Cassegrain telescope into the mobile computing age with the addition of built-in WiFi, allowing the telescope to be controlled wirelessly by an app on your smartphone or tablet. The Evolution does have a conventional hand controller with a simple two-line display, but that is so 1990s! You actually do not even need to connect the hand controller to use the Evolution. It can be aligned and operated strictly from the mobile app.

The app is free and can be downloaded from the Apple iTunes App Store (for iOS devices) or the Google Play store (for Android devices). You need to search for SkyPortal. As an alternative, you can also use Celestron's SkyQ app (\$5), which was adapted from Pocket Universe. SkyQ also works

with Celestron's add-on SkyQ Link accessory that allows adding wireless app control to other Celestron telescopes.

When I conducted the review, the Evolution did not connect to SkySafari, Starmap HD, TheSky HD or other planetary apps that offer telescope control. SkySafari has since been updated to connect to Celestron WiFi scopes. Other apps might follow suit.

SkyPortal is actually a version of the popular SkySafari app, offering full telescope control, like the premium editions of SkySafari, but with a database of deep-sky objects limited to the Messier and Caldwell catalogues for 219 objects, just as with the lowest-cost version of SkySafari.

SkyPortal requires at least iOS 7 or Android 4 to run, so don't plan to use it with that old original iPad or Samsung smartphone still kicking around the house. I also found that I was not able to control the telescope with my four-year-old iPhone 4, even with the supported iOS 7 operating system. The app refused to complete an alignment or locked up, or the telescope spun out of control. My somewhat vintage iPad 3 (from 2012) had some initial difficulty seeing the Evolution's WiFi network, but once connected, it ran the telescope fine. My conclusion: The app requires the latest mobile operating system (as stated



THE EVOLUTION Weighing in at 11.8 kilograms (26 pounds), the 8-inch telescope (single-arm fork mount and tube assembly) attaches to the tripod quickly and securely using a centre guide pin and three captive spring-loaded bolts on the tripod's top plate.



SCT OPTICS (left): The Evolution uses Celestron's standard f/10 (not EdgeHD) optics, which proved to be very sharp. The excellent multicoatings on the corrector plate make the secondary mirror appear to float in midair. **REMOVABLE TUBE** (middle): The optical tube attaches to the mount via a standard Vixen dovetail bar. You could replace this with another tube assembly, such as a short-focus refractor, although aiming high in the sky may be restricted. **A SOLID BASE** (right): The tripod and telescope base have handy receptacles for 2-inch and 1.25-inch eyepieces. Handles on the mount's base and fork arm make it easy to carry the telescope and place it on the tripod.

in the product literature) as well as a fairly current mobile device.

To connect, you simply select the telescope's WiFi network in your device's preferences (it appears as SkyQLink-xx, with the xx being a unique two-character identifier). No device pairing or password is needed to log in. Just how an observing field full of Evolutions and iPad-wielding owners will get along remains to be seen. You could connect to someone else's telescope by mistake—or evil intent—and vice versa!

You can also set up the Evolution and SkyPortal to connect to your home WiFi network (via the “Use Access Point” option), the same network to which your phone or tablet typically connects. The process involves entering the technical address info for your home network and flipping a hardware switch on the telescope. However, the other “Direct Connect” method is the default and is what you would need to use in the field far from home.

APP CONTROL

Once you are connected, the first order of the night is to align the telescope so that it knows where it is pointed in the sky. The telescope does not have GPS or even an internal clock. Your mobile device has all that information. The Evolution also does not use Celestron's SkyProdigy technology, in which a side-mounted camera snaps images of the sky to auto-align the telescope. Instead, you must do the alignment.

To do that with the app, you have two choices: SkyAlign and Manual Align. With Celestron's patented SkyAlign method, you have to use the app's slewing buttons to slew to and centre three objects. They can be any three bright objects in the sky, and you don't need to know what they are. The telescope figures that out for you. Celestron introduced SkyAlign several years ago, and it works amazingly well.



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With Manual Align, you slew to one star you know, then tap on it in the app display to align on it. You then tap on a second star, and the scope slews to it or close to it (it'll be off). You centre the object and align on it. Repeat for a third star. I prefer the Manual Align, as the telescope, not you, does most of the slewing. But you do have to know the identity of several bright stars.

When the scope is aligned, you can slew to any star, planet or deep-sky object displayed by SkyPortal by tapping on the object.



THE MAIN APP The SkyPortal app includes Messier and Caldwell objects. When you are connected, a crosshair shows where the telescope is aimed. Arrows on either side of the screen are for slewing the scope.



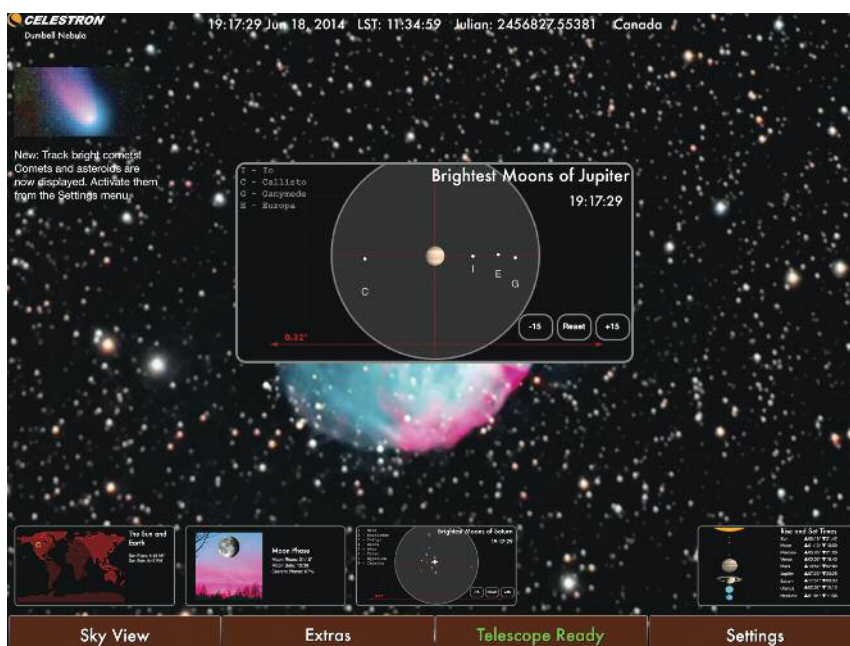
SCOPE SETUP Designed for the Evolution series, SkyPortal provides access to many of the telescope's operating functions, such as battery level, maximum slewing speed, tracking rate and altitude limits.

A "Tonight's Best" list takes you to a few dozen of the best of what's up, a great start for beginners. You can also go to right ascension and declination coordinates you enter into the app, or you can scan the scope around using the hand controller's four slew buttons.

What you cannot do is issue GoTo commands from the hand controller, because the controller thinks the telescope is not aligned and refuses to send the telescope anywhere. Nor can you align using the hand controller then switch to the app to issue GoTo



OBJECTS GALORE The \$5 SkyQ app provides an alternative choice for controlling the Evolution. While it lacks some of the telescope-specific functions, this app contains the complete NGC catalogue as well as bright asteroids and comets.



SKYQ UTILITIES SkyQ has additional features, such as displays of the moons of Jupiter and Saturn, a basic Moon map and tables of current rise and set times for the Sun, Moon and planets. It also has audio commentary.

commands. You must align and command the telescope with one system or the other: mobile app or hand controller.

Once aligned, the Evolution found objects accurately, placing all targets nicely within the field of the 40mm low-power eyepiece.

The SkyPortal app is easy to use and offers access to many of the settings and status readouts (like battery level) that you would normally access through the hand controller.

For many targets, there are excellent audio descriptions that tell you what to look for in the eyepiece—a coloured double star in a star cluster, for example. This feature is superb and really begins to make use of the media capabilities of the amazing computers we carry with us to enhance the observing experience.

But I hope Celestron will add more objects to SkyPortal's modest database, bringing it on par with the SkyQ app, which offers all NGC objects as well as bright asteroids and comets. Another handy addition would be the ability to create custom observing lists offered by the advanced versions of SkySafari.

THE ESSENTIALS

All the high-tech features would be for naught if the optics were fuzzy or the mount shaky. But not so. The Evolution is tack-sharp and rock-steady. Star images were textbook-perfect, and vibrations damped out in one second. The focuser is precise, with no image shift or greasy mushiness to hamper homing in on exact focus.

The other superb feature of the Evolution is its built-in lithium

iron phosphate (LiFePO₄) battery. It delivers 9.6 volts at 4.5 amp-hours, and depending on the amount of high-speed slewing, it powered the telescope for 6 to 10 hours before requiring a recharge. (An AC charger is included, and recharging took about two hours.) To save battery power, you can limit the top slewing speed. External batteries are needed only for extended stays at dark sites away from AC power.

I loved the convenience of the internal battery, and I really like using a tablet to run a telescope. The large screen and star chart make it easy to see where the scope is pointed and what other objects lie nearby for exploration. Tapping on most objects and hitting the Info button brings up a wealth of science information, additional images and, for all the Messier and bright Caldwell's, useful audio descriptions that will help you see more and understand what you are observing.

The late Tom Johnson, who designed the first commercial Schmidt-Cassegrain, would be amazed at how his telescope has evolved. Converging mobile computers with telescopes is a wonderful way to enhance observing and make the experience exciting to a new generation of stargazers. The Evolution takes the Schmidt-Cassegrain to the next level without any sacrifice in the quality of the optics or the mount. ♦

Associate editor Alan Dyer is an experienced user of amateur astronomy equipment. He is coauthor of The Backyard Astronomer's Guide.

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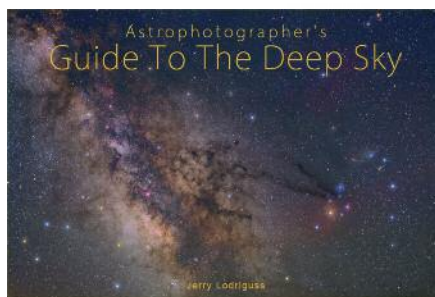
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BOOK REVIEWS

Two how-to books for astrophotographers—a CD-ROM and an e-book—get an enthusiastic thumbs-up from our ace contributing astro-imager Lynn Hilborn



ASTROPHOTOGRAPHER'S GUIDE TO THE DEEP SKY

by Jerry Lodriguss

A CD-ROM available from astropix.com

Jerry Lodriguss has done it again. His new *Astrophotographer's Guide to the Deep Sky* is a welcome addition to his widely acclaimed collection of CD-ROM books, which include *A Beginner's Guide to DSLR Astrophotography* and *A Guide to DSLR Planetary Imaging*.

As an avid astrophotographer, I appreciate the need to develop a disciplined approach to preplanning imaging sessions. Over the years, however, I have managed to end up with a disorganized mass of clip-pings, Post-it notes and scraps of paper with NGC and IC hieroglyphics and, my favourite, assorted images torn from astronomy magazines, all in an effort to catalogue objects that I plan to shoot at a later date. My computer is stuffed with random bookmarks of image-laden webpages waiting for rediscovery should I ever find the time to launch a search. Clearly, I needed organization in my life.

Fortunately, I was given an opportunity to test-drive a copy of *Astrophotographer's Guide to the Deep Sky*. With a catalogue of more than 500 photogenic objects and over 275 images, I have finally discovered a tool to make my planning sessions a breeze.

A critical step in successful astrophotography at any experience level is to know what objects are available at any given time and their location, size and magnitude.

You want to match the focal length of your lens or scope to best frame the object. With Lodriguss's CD-ROM book, you have a "one-stop shopping" approach to all the data you need. The CD-ROM contains a searchable database of over 500 objects listed by name, type, catalogue number, constellation, R.A./Dec., size, magnitude, notes and framing (focal length). The 275+ photographs are taken almost exclusively with a DSLR and are an excellent example of what a moderately priced DSLR can do in deep-space photography. These images alone will entice you to grab your camera and head out under the stars. For my purposes, the greatest benefit is having the photographic catalogue organized by seasons. At one glance, I can preplan my shots for the next three months.

Among the many other gems on this CD-ROM are constellation image maps and an interesting section describing the equipment Lodriguss used to compile the photographic catalogue, as well as some useful notes on exposure times.

Having taken hundreds of astro-images over the years, I find that the *Astrophotographer's Guide to the Deep Sky* is a great help for adding objects to my list of future challenges. This has to be one of the most productive tools for amateur astronomers who are keen on preplanning their astro-imaging sessions.

Jerry Lodriguss is an excellent writer as well as an award-winning astrophotographer. His CD-ROM books are legend, and the legend continues with *Astrophotographer's Guide to the Deep Sky*.



HOW TO PHOTOGRAPH & PROCESS NIGHTSCAPES AND TIME-LAPSES

by Alan Dyer

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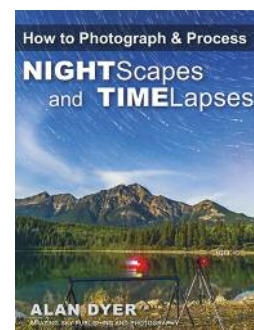
When asked to name the most valued accessory for my DSLR, I used to say it was my tripod or my intervalometer. Now I have a different answer: It's my copy of Alan Dyer's e-book *How to Photograph & Process Nightscapes and Time-Lapses*.

I am in awe of the talent and energy that Dyer has poured into the creation of this impressive 400-page book. I've never seen anything quite like it. It's chock full of 50 embedded HD videos and 60 embedded step-by-step tutorials on processing images.

Dyer spares no effort in engaging the reader with a treasure trove of how-to advice. This comprehensive and concise tome is an absolute treat for visual learners such as myself. It's the Swiss Army knife for every level of DSLR astrophotography.

With detailed sections on equipment and camera operations and on shooting star trails, meteors, eclipses, auroras, the Milky Way, conjunctions, sunrise to sunset transitions, clouds, lightning and rainbows, Dyer masterfully covers it all. Starting the astrophotography journey with still-image nightscapes and taking you to the magic shadows of time-lapse movies, Dyer describes each technique with a breezy, well-illustrated delivery.

The processing sections cover file handling using Adobe Camera Raw, process-



PEERING DEEPER AT SUMMER OBJECTS

Clicking on a portrait of a summer-sky target in Jerry Lodriguss's latest CD-ROM opens a full page that includes details on exposure data, location and object description.

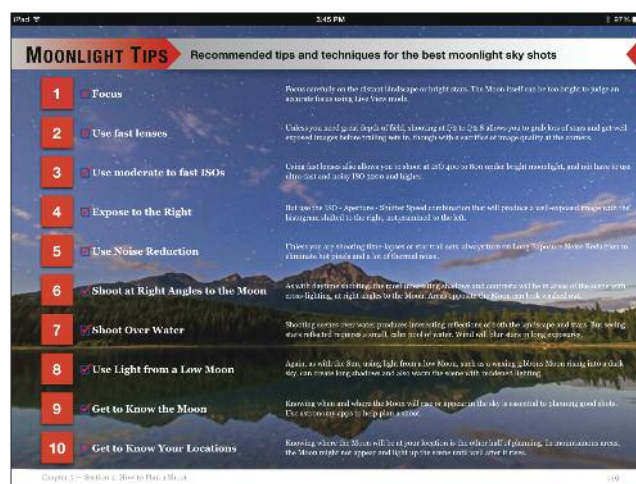
ing in Photoshop and a workflow for Lightroom. For more experienced astrophotographers, Dyer describes how to stack frames for star trails and composites and how to shoot and stitch panoramas. In the section on time-lapse photography, he examines camera and motion control, from a simple fixed tripod to panning for both nighttime and daytime shooting, and for the more advanced astro-imagers, he covers the holy grail: time-lapse photography of transitions from day to night. The chapters, videos and tutorials on processing alone make this e-book a must-have.

As a deep-space photographer who stays indoors at the slightest hint of moonlight, I was delighted to find sections on shooting nightscapes during all phases of the Moon, using the lunar light source to compose stunning landscape portraits. Bravo, more nights without sleep!

If you sometimes struggle to comprehend the sky or your camera, you'll find the basics covered in the "Astronomy 101"

and "Photography 101" sections. Also of note is Dyer's advice throughout about planning your shoot. Perhaps the two most critical elements in achieving rewarding results are to understand how the night sky unfolds and how best to match your equipment and its settings to that dynamic. Dyer examines in detail the motion of the night sky, the field of view of various lenses and the relationship of light and exposure to best capture that special image.

Before you go out and buy that new lens for your DSLR, do yourself a favour and purchase a copy of this e-book. It is the best photographic treat I've had in a long time. As Dyer says, "It's a big book, but it's a big sky." ♦



TIPS FOR STELLAR SHOTS

Each tip is discussed in the preceding pages and is illustrated with detailed examples. This format, which is used throughout the book, covers every aspect of nightscape photography with a DSLR camera.

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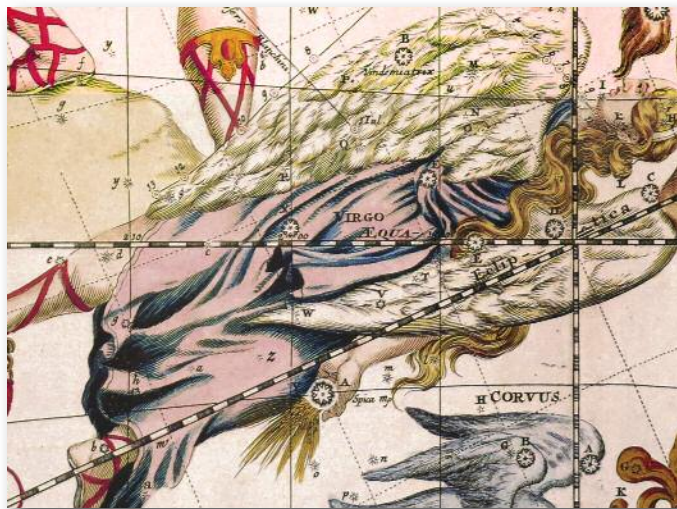
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VIRGO

If Virgo, the daughter of the harvest, were Canadian, she'd be a prairie girl *by Ken Hewitt-White*



VIRGO THE VIRGIN is the Wheat-Bearing Maiden. The connection with grain is not so much because this huge zodiacal constellation appears each spring when the crops are planted but, rather, because the Sun is in the same part of the sky as Virgo at harvesttime. First-magnitude Spica, Virgo's only bright star, is Latin for "ear of wheat," again a reference to the mature crop. The Persian, Syrian and Turkish names for Spica all translate similarly.

Virgo took on an extra portfolio as Astraea, the Greek goddess of justice. Astraea was the daughter of the Chief Justice, Zeus himself. The link is also apparent in her Roman name, Justa. Early on, Virgo was portrayed holding the scales of justice, but in time, these were cut away to form the neighbouring constellation Libra the scales. Even without the symbolic hardware, Virgo remains the biggest constellation of the zodiac and the second largest star group in the entire sky. Virgo spans so much space that the autumn equinox point, which has been precessing westward

from the Libra-Virgo border since 700 B.C., is *still* in Virgo.

A separate and genuinely sad interpretation of Virgo is the story of Eri-gone, who hanged herself in grief over the brutal murder of her father, Ica-rius, a pioneering Greek winemaker. The wine god Bac-chus took pity on both father and daughter and ele-vated them into the starry heavens. Eri-gone was placed in an equatorial region of the zodiac, where we see Virgo today; in fact, modern-day Virgo straddles the celestial equator. Eri-gone's father became Boötes, the kite-shaped constellation to the north.

The stars of Virgo have always traced a female form. In Assyria, Virgo was a wife of high station; in Babylonia, she became Ishtar, Queen of the Stars; and in India, she was the mother of Krishna. Ancient Egyptians occasionally saw the stars as the goddess Isis, divine wife and mother. For medieval Christians, she was no less than a celestial Virgin Mary. Arabian sky-watchers took a more earthly view. They adopted the Greeks' Innocent Maiden but veiled her female form, portraying the constellation as a sheaf of wheat.

And that brings us back to Virgo's affiliation with agriculture. She was the heavenly symbol of a vital early achievement: the sowing and harvesting of grains. Those living in Canada's breadbasket today can relate to that. ♦

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Prize: Sky-Watcher Star Adventurer multipurpose mount and EQ wedge



www.skywatchertelescope.net

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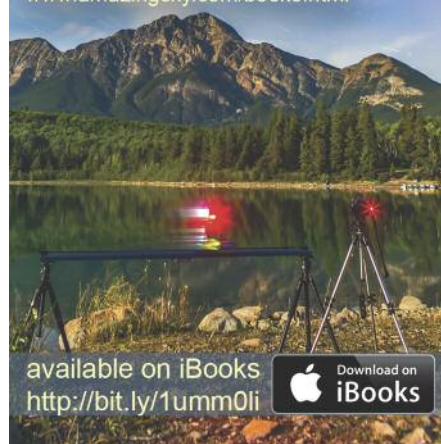
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STAR PARTY CALENDAR

Summer 2015



Dark night skies, telescope viewing and talks for backyard astronomers are the feature attractions at gatherings across Canada this summer. All events are open to everyone. Contact organizers for further details, such as accommodations and fees. PHOTO BY TERENCE DICKINSON

ATLANTIC CANADA

May 22-24

KOUCHIBOUGUAC STAR FEST
Kouchibouguac National Park,
New Brunswick
Organizer: New Brunswick Centre/RASC
Contact: Adrien Bordage, Saint John, N.B.
Tel: 506-646-0226
E-mail: bordagea@nb.sympatico.ca
Website: www.nb.rasc.ca/meeting
information.html

July 1-5

ROYAL ASTRONOMICAL SOCIETY OF CANADA (RASC) GENERAL ASSEMBLY
Astronomy convention held on St. Mary's University campus, Halifax, N.S.
Organizer: Halifax Centre/RASC
Website: www.rasc.ca/ga

July 17-19

COW (CAMPING & OBSERVING WEEKEND) STAR PARTY
Mactaquac Provincial Park, New Brunswick
Organizer: New Brunswick Centre/RASC
Contact: Adrien Bordage, Saint John, N.B.
Tel: 506-646-0226
E-mail: bordagea@nb.sympatico.ca
Website: www.nb.rasc.ca/meeting
information.html

August 14-16

NOVA EAST
Smileys Provincial Park, near Windsor, N.S.
Guest speaker: Alan Dyer
Organizer: Halifax Centre/RASC
Contact: Paul Gray, 1842 Highway 201,

RR 6, Kingston, NS B0P 1R0
E-mail: snpgray@gmail.com
Website: http://halifax.rasc.ca/ne/

August 14-16

MT. CARLETON STAR PARTY
Armstrong Brook Campground,
Mount Carleton Provincial Park,
New Brunswick
Organizer: New Brunswick Centre/RASC
Contact: Adrien Bordage, Saint John, N.B.
Tel: 506-646-0226
E-mail: bordagea@nb.sympatico.ca
Website: www.nb.rasc.ca/meeting
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August 21-23

BUTTER POT STAR PARTY
Butter Pot Provincial Park,
near St. John's, Newfoundland
Organizer: St. John's Centre/RASC
Contact: Randy Dodge, St. John's, N.L.
Tel: 709-745-2903
E-mail: info@stjohnsrasc.ca
Website: www.stjohnsrasc.ca

September 4-6

FUNDY PARK STAR GAZE
Fundy National Park, New Brunswick
Organizer: New Brunswick Centre/RASC
Contact: Adrien Bordage, Saint John, N.B.
Tel: 506-646-0226
E-mail: bordagea@nb.sympatico.ca
Website: www.nb.rasc.ca/meeting
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CENTRAL CANADA

May 7-10

HAROLD HEALY FROZEN BANANA STAR PARTY
Mew Lake Campground,
Algonquin Provincial Park, Ontario
Organizer: North Bay Astronomy Club
Contact: Bill Montague
Tel: 705-495-3540
E-mail: wmontague@cogeco.ca
Website: www.gatewaytotheuniverse.org

June 11-14

THE NEW MOON IN JUNE STAR PARTY
Grundy Lake Provincial Park, Ontario
Organizers: North Bay Astronomy Club
& Sudbury Astronomy Club
Contact: Robert or Lillian Chapman
or Linda Pulliah
Tel: 705-386-7087 (Robert/Lillian)
or 705-671-8127 (Linda)
E-mail: bobandlil14@gmail.com
Website: www.gatewaytotheuniverse.org

July 9-12

11TH ANNUAL VIDEO STAR PARTY
Johnstown, near Prescott, Ontario
Organizer: Ottawa Valley Astronomy
and Observers Group
Contact: Rock Mallin
Tel: 613-925-7592 or 613-749-7592
E-mail: mallincam@gmail.com
Website: www.mallincam.net/
video-star-parties.html

July 9-12

GATEWAY TO THE UNIVERSE STAR PARTY
Marten River Provincial Park, Ontario
Organizer: North Bay Astronomy Club
Contact: Robert or Lillian Chapman
Tel: 705-386-7087
E-mail: bobandlil14@gmail.com
Website: www.gatewaytotheuniverse.org

July 17-20

STARGAZING MANITOULIN STAR PARTY
Gordon's Park Dark Sky Preserve,
Manitoulin Island, Ontario
Organizer: Gordon's Park
Contact: Rita Gordon, Manager
Tel: 705-859-2470
E-mail: rita@gordonspark.com
Website: www.gordonspark.com

August 11-13

PERSEIDS METEOR PARTY
Gordon's Park Dark Sky Preserve,
Manitoulin Island, Ontario
Organizer: Gordon's Park
Contact: Rita Gordon, Manager
Tel: 705-859-2470
E-mail: rita@gordonspark.com
Website: www.gordonspark.com

August 12 (one evening only)

CHARLESTON LAKE ASTRONOMY NIGHT
Charleston Lake Provincial Park,
near Brockville, Ontario
Astro-talk by Terence Dickinson
at 8 p.m., followed by meteor and
telescope viewing
Organizer: Park staff
Tel: 613-659-2065
Website: www.ontarioparks.com/park/
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August 13-16

THE AUGUST STAR PARTY
Marten River Provincial Park, Ontario
Organizer: North Bay Astronomy Club
Contact: Robert or Lillian Chapman
Tel: 705-386-7087
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Website: www.gatewaytotheuniverse.org

August 13-16

STARFEST 2015
River Place Park,
near Mount Forest, Ontario
Organizer:
North York Astronomical Association
Contact: Tony Ward
Tel: 905-668-8798
E-mail: tonyward@rogers.com
Website: www.nyaa.ca

August 14-17

MANITOULIN STAR PARTY
Gordon's Park Dark Sky Preserve,
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Organizer: Gordon's Park
Contact: Rita Gordon, Manager
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E-mail: rita@gordonspark.com
Website: www.gordonspark.com

August 27-30

5TH ANNUAL HALF THE NIGHT STAR PARTY
Halfway Lake Provincial Park, Ontario
Organizer: Sudbury Astronomy Club
Contact: Linda Pulliah,
113 Logan Ave., Sudbury, ON P3C 3E4
Tel: 705-671-8127
E-mail: pulliah@fibreop.ca

September 11-13

THE ROC (LE RENDEZ-VOUS DES OBSERVATEURS DU CIEL)
Saint-Romain, Quebec
Organizer: Pierre Tournay
Contact: Pierre Tournay
Tel: 450-458-7050
E-mail: cygnusX1@aei.ca
Website: www.roc-qc.net

September 11-13

FALL 'N' STARS
Vanderwater Conservation Area,
near Thomasburg, Ontario
Organizer: Belleville Centre/RASC
Contact: Greg Lask
Tel: 613-541-8101
E-mail: glatlat@gmail.com
Website: www.rascbelleville.ca/fallinstars

September 11-14

DARK SIDE OF THE MOON STAR PARTY
Gordon's Park Dark Sky Preserve,
Manitoulin Island, Ontario
Organizer: Gordon's Park
Contact: Rita Gordon, Manager
Tel: 705-859-2470
E-mail: rita@gordonspark.com
Website: www.gordonspark.com

October 9-13

AURORA BOREALIS STAR PARTY
Gordon's Park Dark Sky Preserve,
Manitoulin Island, Ontario
Organizer: Gordon's Park
Contact: Rita Gordon, Manager (see above)

WESTERN CANADA

May 16

BEYOND THE BIG DIPPER

Rock Creek Campground, East Block,
Grasslands National Park, Saskatchewan
Organizers: Parks Canada and RASC

Contact:

Grasslands National Park Visitor Centre

Tel: 306-298-2257

E-mail: grasslands.info@pc.gc.ca

Website: www.pc.gc.ca/grasslands

July 17-19

ALBERTA STAR-B-Q

Eccles Ranch Observatory,
north of Caroline, Alta.

Organizer: Calgary Centre/RASC

Contact: Roland Dechesne

E-mail: rasc.calgary@gmail.com

Website: www.calgary.rasc.ca/starbq.htm

July 25

SLEEP-UNDER-THE-STAR PARTY & CONCERT WEEKEND

Frenchman Valley Campground,
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Saskatchewan

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Contact:

Grasslands National Park Visitor Centre

Tel: 306-298-2257

E-mail: grasslands.info@pc.gc.ca

Website: www.pc.gc.ca/grasslands

August 8-16

MT. KOBAN STAR PARTY

Summit of Mount Kobau,
near Osoyoos, B.C.

Organizer:

Mount Kobau Astronomical Society

Contact: Jim Failes

Tel: 250-763-6962

E-mail: info@mksp.ca

Website: www.mksp.ca

August 13-16

SASKATCHEWAN SUMMER STAR PARTY

Cypress Hills Interprovincial Park
& Dark Sky Preserve, 30 kilometres
south of Maple Creek, Sask.

Organizers:

Saskatoon and Regina Centres/RASC

Contact: Rick Huziak

Tel: 306-665-3392

E-mail: sssp.sk@sasktel.net

Website: www.usask.ca/rasc/starparty.html

August 14-16

20TH ANNUAL ISLAND STAR PARTY

Bright Angel Park, Vancouver Island,
north of Victoria, B.C.

Organizer:

Cowichan Valley StarFinders Society

Website: www.starfinders.ca

August 21-23

THEBACHA & WOOD BUFFALO

DARK SKY FESTIVAL

Fort Smith/Wood Buffalo National Park,
Northwest Territories

Organizer: Thebacha & Wood Buffalo

Astronomical Society

Contact: Mike Couvrette

Tel: 867-872-0243

E-mail: info@tawbas.ca

Website: www.tawbas.ca

September 8-13

NORTHERN PRAIRIE STAR PARTY

Black Nugget Lake Campground,
southeast of Tofield, Alta.

Organizer: Edmonton Centre/RASC

Contact: Rick Bramm

Website: edmontonrasc.com/

northern-prairie-star-party

September 11-13

ALBERTA STAR PARTY

Starland Recreation Area Campground,
north of Drumheller, Alta.

Organizer: Calgary Centre/RASC

Contact: Nic David or Judy Sterner

Tel: 403-932-6569

E-mail: albertastarparty@gmail.com

Website: calgary.rasc.ca/asp.htm

September 11-19

MERRITT STAR QUEST

Near Merritt, B.C.

Organizer: Merritt Astronomical Society

Website: www.merrittastronomical.com

October 16-25

JASPER DARK SKY FESTIVAL

Jasper National Park & Town of Jasper, Alta.

Organizer: Tourism Jasper

Contact: Bryan

Tel: 780-852-2124

E-mail: bryan@jaspercanadianrockies.com

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It's springtime, and Ken looks w-a-a-y up, to the Great Beyond

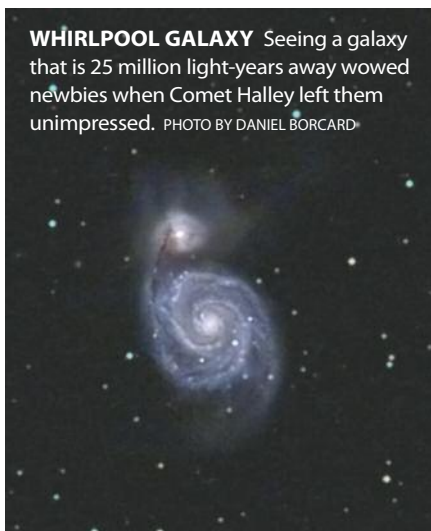
MID-MAY; NIGHTFALL. I'm outside watching the sky show. I look high in the southwest for Leo, face south to find Virgo, swing eastward for Hercules, then gaze straight up at the Big Dipper. Stop right there. Truth to tell, this is my least favourite time of year for ogling the iconic Dipper, because I have to crane my neck to see it!

From my location in southwestern British Columbia, a stone's throw north of the 49th parallel, I notice that when the Dipper is highest, six of its seven stars slide just slightly north of the zenith. The final star at the end of the Big Dipper's handle, second-magnitude Alkaid, passes *directly* overhead. Watching Alkaid culminate really is a pain in the neck.

Sore sight or not, a culminating Dipper is a clarion call for galaxy hunters. That's because when the Dipper is high, the band of the Milky Way is low. In fact, right now the plane of our Milky Way Galaxy is virtually level with the horizon. Having the Milky Way *out* of the way means we're observing through less interstellar dust and gas than during other seasons. Our telescopes have a clearer view of the cosmos at large. The Dipper overhead beckons us to peer through this "galactic window" at the myriad galaxies of the Great Beyond.

I love targeting galaxies near the Dipper because there's less haze and light pollution up there. Minimal atmospheric interference is one of the reasons I've chosen a pair of edge-on galaxies in the constellation Draco for my "Scoping the Sky" column on page 34. In mid-May, those far-off fuzzies slip past the dark zenith around midnight. Of course, nothing's perfect. My star-hop to the galaxies begins at that pain-in-the-neck star Alkaid, which, when it buzzes the

WHIRLPOOL GALAXY Seeing a galaxy that is 25 million light-years away wowed newbies when Comet Halley left them unimpressed. PHOTO BY DANIEL BORCARD



zenith, is tough to sight through my finder-scope. And nudging my 10-inch Dobsonian in azimuth is harder when the tube is pointing straight up. But Ken, the galaxy fanatic, perseveres.

I remember one occasion when aiming high practically saved my reputation. On a cold night in March 1986, I led a group of nonastronomy friends from Vancouver on an all-night drive to a distant B.C. provincial park to witness that once-in-a-lifetime celestial showstopper, Halley's Comet. The comet was drifting southward through Sagittarius and wouldn't rise until nearly dawn, but that didn't deter us (we were young). Alas, the overhyped Halley presented an underwhelming visage, even in my monster 17.5-inch Dobsonian. No oohs and aahs from my chilly chums. Desperate to salvage the occasion, I raised the seven-foot tube past Alkaid to the Whirlpool Galaxy, M51, hoping the famous face-on would impress. It did. Magnified 285 times, the spiral arms glowed with almost photo-

graphic clarity. Getting eyeball to eyepiece meant guiding each person up a ladder, but my reward was hearing utterances of incomprehension as I remarked that the swirl of starlight was over 25 million light-years away.

Fast-forward to mid-May 2002, when I erected the same hefty light-bucket in a remote park. My objective that coal-black night was to star-hop from Alkaid to another top-of-the-sky prize: M101, the Pinwheel Galaxy. M101 is slightly closer to us than M51, and it appears larger; however, its broad, round face is pale. A 63x eyepiece yielded only vague whorls of light. The 285x view revealed some detail, but at the expense of precious contrast. And I had to constantly recentre the high-power image. Standing on the ladder, it was awkward (dangerous, actually) keeping the vertical tube on-target. A workable compromise occurred at 154x. Patient staring revealed long, lumpy portions of three distinct arms curling away from the galaxy's central hub. Ah, success. The shy Pinwheel smiles obligingly when it's high up and the viewer is far from city lights. (For a fine portrait of M101, see page 15 of the March/April 2015 *SkyNews*.)

Don't get me wrong. I enjoy scoping clusters and nebulae along the Milky Way. But the awe intensifies when I scan the wider cosmos. Beholding galaxies like the Whirlpool and Pinwheel never fails to turn my mental gears. I urge you to go deep and scrutinize such wonders yourself. After all, it's spring again...time to push past the Dipper and grasp the Great Beyond. ♦

Contributing editor Ken Hewitt-White secretly enjoys craning his neck to view all manner of celestial objects.



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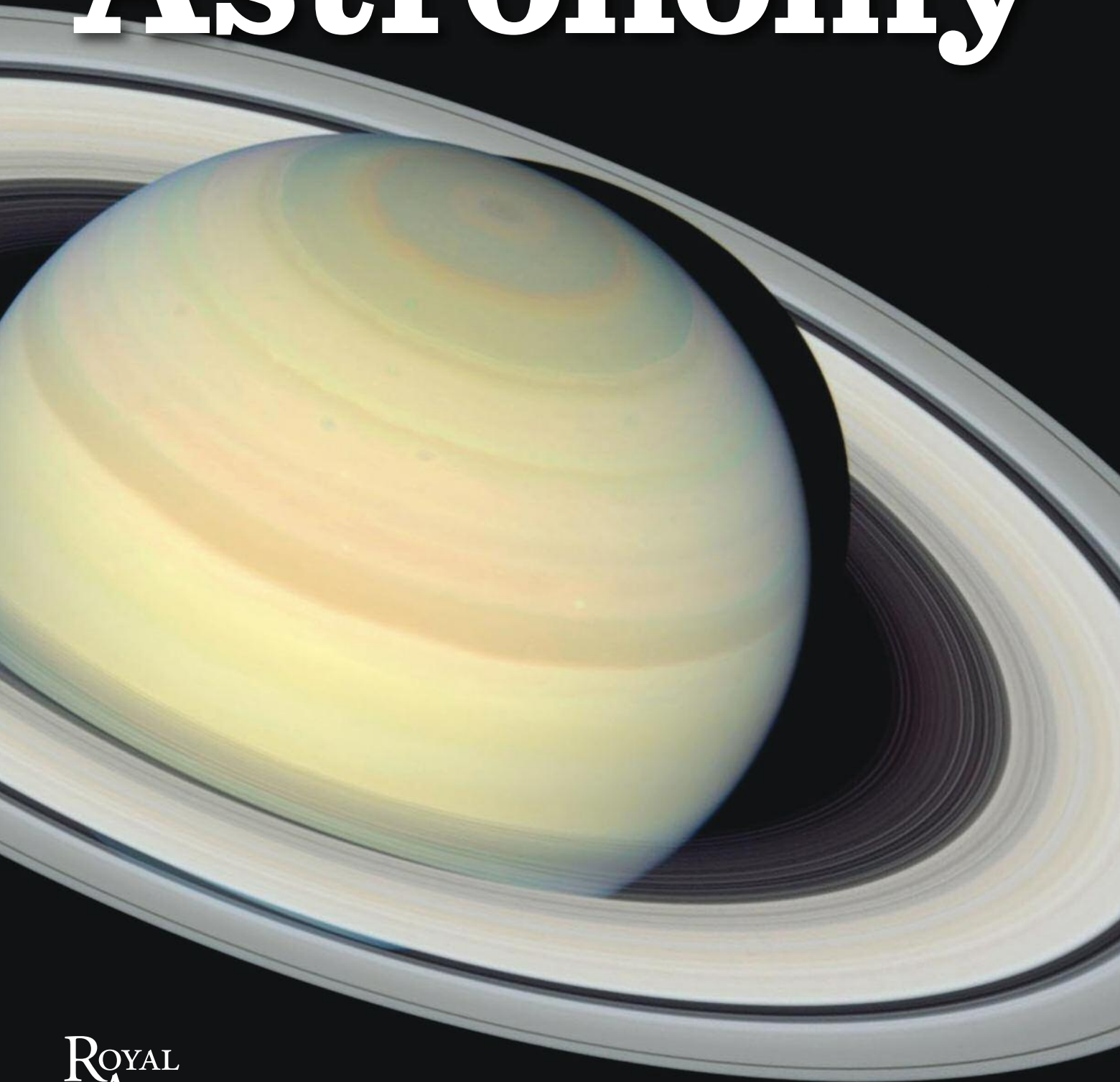
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Getting Started in Astronomy



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The universe is a vast, magnificent place. And it's yours to explore on any clear night. What is there to see? Do I need a telescope? Can I photograph stars? Questions like these are usually among the first that come to mind when you consider getting into astronomy. This brief guide will help answer them and many more. Let's get started!

By Gary Seronik

Look up...

Although many people assume that you need a telescope to enjoy astronomy, that's not always true. Plenty of sights are best seen with just your eyes. Constellations, meteor showers, the northern lights, Earth-orbiting satellites and conjunctions of the Moon and planets are best experienced without optical aid.

Tracing the constellations is a particularly enjoyable way to become involved in astronomy. A star map showing the current season's sky, a dim red flashlight (to preserve your night vision) and a comfortable chaise longue are the only equipment you really need. Different constellations are visible throughout the night and at different times of the year. Indeed, once you start paying attention, you'll find the passing seasons are as easily recognized by the march of constellations across the sky as by changes in the weather.

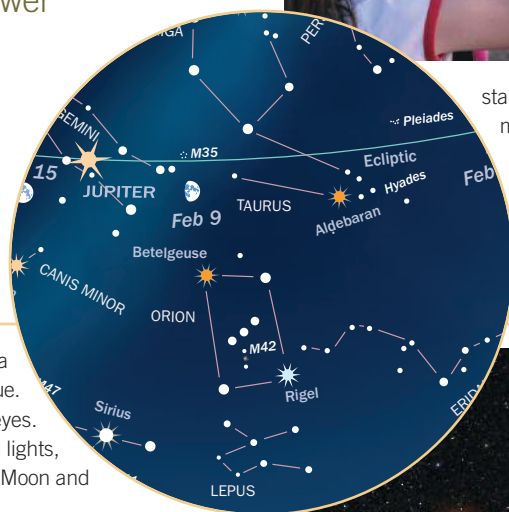
Learning the constellations is also a very helpful step if you decide to explore the sky with binoculars or a telescope. Think of the constellations as celestial countries. In the same way you couldn't visit Toronto without knowing that it's a city in Ontario, in a country called Canada, you couldn't point to a star like Betelgeuse or Rigel without first being able to identify Orion, the winter constellation in which these stars reside. When you're familiar with the main constellations in each season, finding individual stars, clusters, galaxies and nebulae becomes much easier.

MIGHTY ORION Dominated by bright red Betelgeuse, blue-white Rigel and the three stars that form his famous belt, Orion the hunter, right, is one of the winter sky's brightest constellations. This photograph also shows stars too faint to be seen with your unaided eyes alone. Above: A chart like this one, from *SkyNews* magazine, is indispensable for identifying constellations. PHOTO: GARY SERONIK

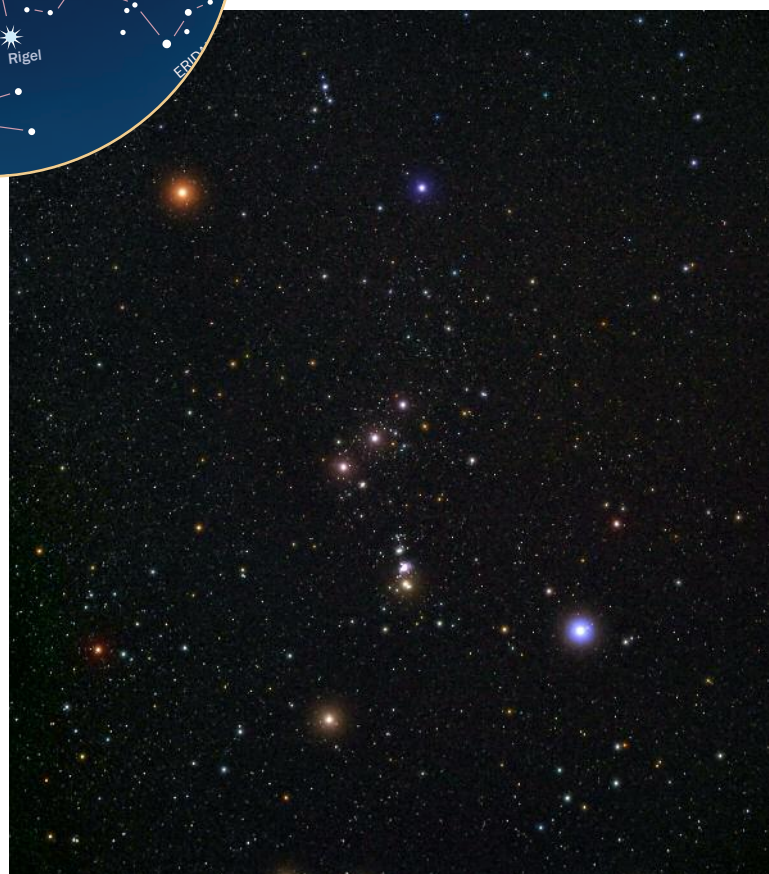
Who Are We?



Backyard stargazers, or "amateur astronomers," come from all walks of life. To become one, you don't need to take a test, have a university degree or possess a special licence. All you need is curiosity and a desire to see what's up there. You don't even have to go "all in." Some amateurs spend their nights trying to glimpse obscure galaxies with a big telescope, while others enjoy nothing more than kicking back to watch the stars slowly come out on a summer evening. How much or how little you do is entirely up to you. There's only one proviso: If you're not having fun, you're doing it wrong. PHOTO: GARY SERONIK



Look Waaay up





ABOVE: MOON PHASE SERIES BY GARY SERONIK

Enter the Binocular Universe

You can significantly extend your astronomical reach with binoculars. Consider that under a good sky without optical aid, you can see close to 3,000 stars. Ordinary binoculars increase that count to 150,000! Chances are, you already own binoculars, so give them a try. You might be pleasantly surprised by what you can see. Start with the Moon—it's amazing in binoculars. You can see the largest craters and identify dozens of individual features. And that's not all. Once you know your way around the constellations, binoculars will allow you to sweep up interesting star clusters, nebulae and even distant galaxies. Binoculars excel at showing large areas of sky—something telescopes don't do very well. That's why experienced amateur astronomers usually keep binoculars close by.

What kinds of binoculars are best for stargazing? There are many options, but two specifications are the most important: the magnifying power and the size of the front lenses. Luckily, these two crucial pieces of information are normally printed right on the binoculars.

Typically, you'll see something like 7x35, 8x40 or 10x50.

The first number is the magnification, and the second gives the diameter of the front lenses in millimetres. For example, 7x35 binoculars magnify seven times (7x) and have a pair of front lenses that are each 35 millimetres across. Similarly, 10x50s magnify 10 times (10x) and have 50-millimetre front lenses.

So which power/aperture combination works best for astronomy? As with so many things, there are inevitable trade-offs, but most amateur astronomers find that 7x50s, 8x56s or 10x50s are excellent choices. I personally prefer the detail that the extra magnification of the 10x50 size provides, though some opt for the wider fields of view that 7x50s offer. As I said, there are trade-offs. If possible, try before you buy.

To use binoculars effectively for astronomy, you must be able to hold them steadily—something that gets tougher when the binoculars magnify more than 7x or when they're heavy—which is why many binocular astronomers use a tripod or specialized mount. Others prefer the convenience of image-stabilized binoculars, which have an internal opto-electrical mechanism that counteracts the jiggles introduced by hand-holding them. Engaging the stabilization produces an almost magical steadying effect that works wonders for stargazing. My favourites are the image-stabilized binoculars made by Canon.



THE BIG PICTURE One of the great pleasures of amateur astronomy is scanning the Milky Way, above, through binoculars. PHOTO: ALAN DYER Left: Ranging in size from diminutive to domineering, all binoculars have some astronomical uses. The trick is to avoid binoculars that are too big or too small—you want a pair that is “just right.” For many enthusiasts, 7x50s, 8x56s or 10x50s fit the bill. Binoculars typically have fields of view five to seven degrees across, wide enough to hold 10 to 14 full Moons. That makes them the optic of choice for big eye-catching objects like the beautiful Pleiades star cluster, in Taurus, inset above. PHOTOS: GARY SERONIK (BOTH)

ON THE COVER: Few telescopic sights can match the appearance of Saturn and its impressive ring system. This Hubble Space Telescope view reveals the planet in breathtaking detail, with a clarity not possible in backyard telescopes. However, even a modest instrument can show the rings quite readily. PHOTO: NASA/HUBBLE HERITAGE TEAM

GARY SERONIK, a well-known Canadian astronomy author and an enthusiastic backyard stargazer, is the editor of the *SkyNews* website. He explores the universe from his home in Victoria, British Columbia.



Blinded by the Light

Most people live in or near a major city. So the night sky that the majority of us see is badly compromised by light pollution, which illuminates the air above us. The resulting glow washes out all but the brightest stars. Light pollution is the single greatest barrier to being able to appreciate the wonders of the universe from your backyard. If you've ever been under a truly dark country sky on a moonless night (see photo, page 7), you already know that the difference can be like night and day. Because of the wide effects of light pollution today compared with when our grandparents were young, avid stargazers travel far from home to use their telescopes.

Light pollution is pure waste spread brightly across the sky, the result of poorly designed outdoor light fixtures or ill-considered lighting strategies that allow excessive "light spill." It consumes tremendous amounts of electricity annually and produces no benefits. Indeed, quite the contrary. Studies have shown that excessive night lighting has serious health consequences for humans, detrimentally affects the behaviour of nocturnal animals and alters the migratory patterns of birds. And yet it's largely preventable. If you'd like to learn more about light pollution and what you can do to reduce it, visit the website of the International Dark-Sky Association (www.darksky.org/).

WASTED LIGHT IN SPACE Utilizing data acquired in 2012, this NASA image of the Earth's western hemisphere at night clearly illustrates the amount of light sent out into space rather than down on the ground where it's needed. COURTESY EARTH OBSERVATORY/NASA

TELESCOPE MATTERS

Refractors, like the 66-millimetre instrument shown here, below left, gather light with a high-quality lens and offer sharp views of the Moon, right, and planets. Below right: This Dobsonian reflector features a 300-millimetre mirror to pull in lots of light.

PHOTOS: GARY SERONIK (ALL)



Astronomy = Telescope

It's hard to deny that stargazing and telescopes go hand in hand. And why not? A telescope really opens up the universe for detailed exploration. Even a modest instrument can show incredible detail on the Moon's surface, Saturn's beautiful rings, Jupiter's subtle cloud belts and countless star clusters, nebulae and galaxies. With a good telescope, a lifetime's worth of sky sights awaits.

Telescopes are available in a bewildering array of shapes and sizes, and selecting one can be daunting. But one consideration overrides all others: When it comes to seeing fine lunar and planetary detail or glimpsing distant, faint galaxies, bigger is definitely better. More than any other single factor, the telescope's aperture (the size of its main light-gathering optical element) determines what the instrument can deliver. Simply put, in the realm of telescopes, aperture is king.

But what about magnification? Isn't a 500x telescope better than a 100x instrument? The short answer is no. Magnification is essentially a meaningless specification. Here's why. A telescope's magnification is set by the eyepiece—the part through which you actually look. All astronomical telescopes use interchangeable eyepieces that allow you to select the magnification. As a result, any telescope can be made to magnify to any power depending on which eyepiece you choose. But how good the views are at a given magnification is based on the telescope's aperture. For example, 200x in a 2-inch telescope produces views that are quite dim and blurry, while the same magnification in a larger telescope can yield bright, crisp images. Bottom line: Don't buy a telescope on the basis of its magnification. Any telescope promoted that way is very likely of poor quality and targeted at the impulse shopper.

Telescopes come in several optical varieties, each one having its supporters and detractors. A refractor telescope uses a lens to gather light. The so-called apochromatic refractor has more complex lenses that generally provide the best image quality, though perfectly acceptable images can be seen in an ordinary "achromatic" refractor. Quality at a premium price is the refractor's calling card. The Newtonian reflector telescope uses a precisely curved mirror to gather light. Such instruments offer excellent bang for the buck, especially in the simple Dobsonian configuration. The biggest telescopes in the hands of recreational astronomers are reflectors. Com-

MAGNIFICATION

MATH Eyepieces like these are crucial for powering your scope. To determine your telescope's magnification, simply divide the focal length of the telescope by the focal length of the eyepiece. For example, a 24-millimetre eyepiece used in a telescope with a focal length of 1,000 millimetres will yield 42x ($1,000 \div 24$). A 10-millimetre eyepiece in the same telescope will produce 100x.



pound telescopes that utilize both lenses and mirrors are another popular variety of astronomical instrument. The Schmidt-Cassegrain telescope (SCT) and the Maksutov are the most common. They offer a lot of aperture in a compact package, a combination that makes them particularly appealing to amateur astronomers who must travel to observe.

Each type of telescope comes in a wide range of apertures and prices and can be carried on different styles of mount. An altazimuth mount moves the telescope in simple up-down and left-right motions, like a super-beefy camera tripod. A Dobsonian telescope utilizes a specific kind of altazimuth setup. In an equatorial mount, one of the axes is tilted toward the north celestial pole, which simplifies the motion needed to follow sky targets. Either style can be motorized and equipped with computerized controls for GoTo pointing and tracking.

Detailed descriptions of all the available telescope and mount configurations are beyond the scope of this booklet, and as with so many things, there is no one "best" choice. A telescope is a major purchase, so it pays to do your homework. If you can, visit a telescope store or attend a star party and kick the tires in person. Don't overlook practical considerations, such as size and weight. Try to imagine setting up and using the telescope night after night or at a remote location. Is it too big or heavy to handle? Find out what accessories are included, and set aside some of your budget to purchase extra eyepieces. A little research in advance will save you a lot of grief later. A great place to start is with a copy of Terence Dickinson and Alan Dyer's excellent book, *The Backyard Astronomer's Guide*. It's chock full of detailed telescope information and practical hands-on advice.

Finally, if you've decided the time is right to buy your own telescope, resist the urge to pop down to the local mall or megastore. These places often sell instruments that are little more than telescope-shaped junk. For something that will bring you lasting enjoyment, visit a store that specializes in optical equipment or purchase online from a reputable telescope dealer.

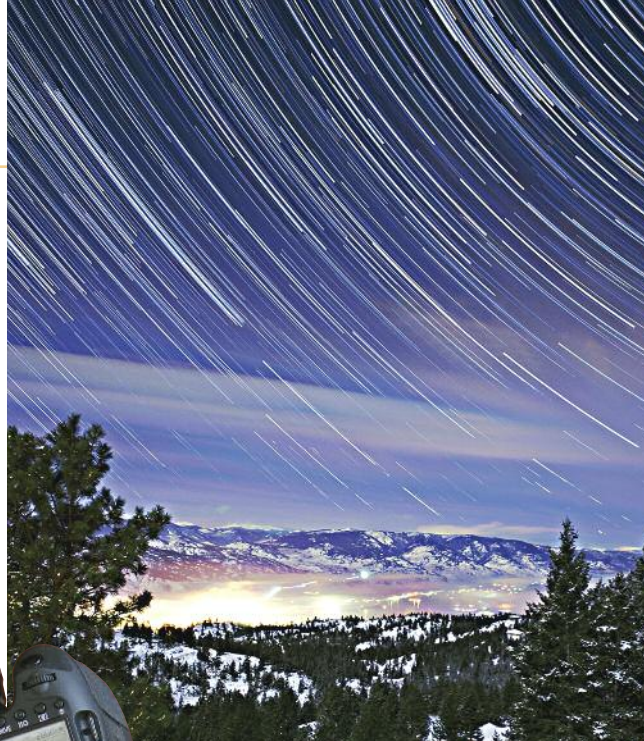
Picture This

Viewing the universe for yourself is the central attraction of backyard astronomy. The desire to photograph and share what you see is a natural extension of the experience.

The main difference between using your camera during the day and using it to take shots of the night sky is, not surprisingly, a lack of light. This means two things. First, you'll need to use a tripod. Second, your camera has to be able to take exposures of 30 seconds or longer. But even with a setup as basic as this, you can capture beautiful scenic nightscapes, photograph the northern lights, make star-trail images and even take constellation portraits. The very best results are obtained with digital SLRs. Such cameras typically perform very well in low-light conditions and allow you to select a lens that best suits your subject.

Once you've mastered camera-and-tripod shooting, the next step up the astrophotography ladder is long-exposure photography utilizing some kind of tracking mount. This specialized equipment compensates for the Earth's rotation, which causes stars to appear as streaks in photos, rather than sharp points of light. With the right lens, you can capture all kinds of astro-images, ranging from constellations to star clusters, galaxies and nebulas. Suitable tracking mounts can be purchased from most telescope dealers.

But what if you want to photograph the Moon, planets and even nebulas and clusters in detail? For that, you have to be able to attach your camera to your telescope, which then works like a powerful telephoto lens. This kind of imaging is the most demanding and is best suited to experienced shooters.



STREAKING STARS A long-exposure photograph records not only starlight but also the Earth's rotation, which transforms stars from neat points of light into bright, curving streaks. PHOTO: TREVOR TIGNER A dedicated tracking mount, like the iOptron SkyTracker at left, compensates for the Earth's rotation and allows long-exposure images without the trailing stars. PHOTO: TERENCE DICKINSON

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Going Deeper

If you are interested in the universe of amateur astronomy, consider getting in touch with a local astronomy club. The Royal Astronomical Society of Canada (RASC) has branches across Canada, where you'll find like-minded individuals who are happy to share their enthusiasm for astronomy and to answer your questions. RASC Centres have regularly scheduled meetings that are open to the public and feature guest speakers. Most RASC Centres also host observing nights, where you can look through telescopes set up by the members and tap into their immense wealth of experience. It's an ideal way to get a feel for what recreational astronomy is all about and what's overhead for you to see. For more information about the RASC and to find a Centre near you, visit the RASC's website (www.rasc.ca).

Literally a lifetime's worth of information is available in your local library, at bookstores and on the internet. Of the many introductory books on astronomy, none is better than Terence Dickinson's classic *NightWatch*. This superb volume features lively text covering the full spectrum of recreational astronomy and includes nicely rendered star charts. A more in-depth work is the previously mentioned *Backyard Astronomer's Guide* by Dickinson and Alan Dyer—a must-have, especially if you are contemplating the purchase of a telescope or any other astronomical equipment. A good star atlas is also very useful. *Sky & Telescope's Pocket Sky Atlas* is an excellent choice.

The hobby is well served by several fine magazines, including one produced in Canada: *SkyNews*. Each issue is packed with amazing colour images, observing charts and event listings, as well as regular contributions from Canada's finest astronomy writers. The magazine also has an informative and up-to-date website (www.SkyNews.ca).



NIGHT WATCHERS Few things are more rewarding for stargazers than a clear night sky filled with stars in the company of fellow enthusiasts. *SkyNews*, the Canadian magazine of astronomy and stargazing, left, is a wonderful resource for backyard astronomers of all levels of experience. PHOTO TOP: TERENCE DICKINSON

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A GALAXY FAR, FAR AWAY Lying some 30 million light-years distant, the Whirlpool Galaxy (M51) is one of the few galaxies whose spiral structure can be glimpsed with a typical backyard telescope under good conditions. However, the details seen even in a big telescope are much more subtle than they appear in this long-exposure digital photograph.

PHOTO: NOAO

Ready, Set, Explore!

One of astronomy's greatest attractions is that it connects us personally to the vast universe in which we live. One good telescopic look at the Moon's stark, battered surface instantly transports you to a world utterly unlike the one we inhabit. Seeing Saturn's stunning rings for yourself is like meeting a celestial celebrity. And it can be humbling to observe the faint light of a distant galaxy and realize that the photons you're absorbing through the eyepiece at that moment have been travelling across space far longer than there have been humans on our planet. The universe is, indeed, a magnificent place—not only for its visual splendour but for what it truly is. Getting started in astronomy is your ticket to exploring and understanding that magnificence.

A SHOT FROM THE DARK The rare spectacle of a bright comet is one of backyard astronomy's greatest prizes. Comet Hale-Bopp was one such object, delighting night-sky enthusiasts in the spring of 1997. The comet could be seen easily without optical aid and was a stunning binocular sight.

PHOTO: GARY SERONIK

